M. A. EL-SAYED

PROFESSIONAL DOSSIER

Undergraduate Education:
B Sc: Ein Shams University, Cairo, Egypt.

Graduate & Post-graduate Education:
Ph. D.: Florida State University, Tallahassee, Florida,
Research Associate, Yale University,
Research Associate, Florida State University,
Research Associate, Harvard University,
Research Associate, California Institute of Technology,

Positions Held:

International Committees membership:

A.University of California (LA):

Assistant Professor	1961-1994
Associate Professor	1964-1967
Professor	1967-1994

B. Georgia Institute Of Technology:

Juilius Brown Professor	1994- now
Regent Professor	2000-now

C. Visiting Professorial Positions:

American U. of Beirut,	1967-1968 (Visiting Professor)
University of Paris,	1968 (Visiting Scholar)
California Institute of Technology, Pasadena	1980 (Sherman Fairchild Distinguished, Scholar)
Technical University of Munich	1981 (Alexander von Humboldt Senior Fellow).

D. Editor-in-Chief: 1980-2004 — The Journal of Physical Chemistry
American Chemical Society, Publication.

E. Editor: 1990-2000 — International Review of Physical Chemistry.
Georgia Institute of Technology, 1994-
Georgia Institute of Technology, 2000 -

E.Miller Visiting Professor: 2007 — University of California, Berkley, California, 2007

Recognitions: Election to Learned Societies and Membership of National and International Committees

Elected Member of the USA National Academy of Sciences, 1980.
Elected Associate Member of the Third World Academy of Sciences,1984.
Selected member of the USA-Chinese Academy of Sciences Exchange Program, Summer1984
Elected Member and Vice President of the Physical Chemistry Division of IUPAC, 1985-1989 and 1991-1995.
Elected Fellow of the American Academy of Arts and Sciences, 1986.

Elected Member at Large and Vice Chairman of the U.S. National Research Council Committee for the International Union of Pure and Applied Chemistry, 1987-1991.
Elected to the Board of Trustees of Associated Universities, Inc. (Managing Brookhaven National Laboratory and the National Radio Astronomy Observatory), 1988-1991.
Elected chairman of the U.S. National Research Council Committee for the International Union of Pure and Applied Chemistry, 1990-1992.
Member of the Division of Physical Chemistry, IUPAC,1993-1995.
The Foreign Councilor of the Institute of Molecular Science, Okazaki, Japan,1994-1997.
Member of the Board of Chemical Sciences,National Research Council, USA.National Academy of Sciences, 1994-1997.
Elected member of the American Association for the Advancement of Science(1999).
Elected to be ARegent Professor, Georgia Institute of Technology, 2000-
Elected Fellow of the American Association for the Advancement of Science, 2000.
Elected Fellow of the American Physical Society, 2000.
Honorary Fellow of the Chemical Research Society of India, 2000
Member of the Basic Energy Sciences Advisory Committee (BESAC)of the Dept.of Energy 2001-2011.
Member of the Mathematical and Physical Science Advisory Committee of NSF, 2003-2006
Elected Member of the U.S. Academy of Sciences, 1978
Elected Member of the American Physical Society, 1998
Member of the International Council of Scientific International Unions of Pure and Applied Chemistry
Member of ACS National Awards Committee for the Irving Langmuir Award in Chemical Physics 2005 –
Member of the External Advisory Board to the Michigan Nanotechnology Institute for Medicine and Biological Sciences 2006 –
Member of the Jean Sindab Endowment Advisory Board at Winship Cancer Institute, 2006
Inaugural Elected Fellow of the American Chemical Society, 2009 (First year this is given)
Elected Honorary Member of the Indian Chemical Society, 2008.
Elected Honorary Fellow of the Chinese Chemical Society, 2009.

Awards And Recognitions

The Distinguished Teaching Award, UCLA, 1964
The Alfred P. Sloan Fellowship, September 1965-September 1971
John Simon Guggenheim Memorial Foundation Fellowship, 1967-1968
Fresenius National Award in Pure and Applied Chemistry, April 1967
The McCoy Research Award, UCLA, October 1969
The American Chemical Society, California Section, Gold Medal Award, 1971
Sherman Fairchild Distinguished Scholar at Caltech, Fall Quarter 1980
Recipient of the Egyptian American Outstanding Achievement Award, 1988
Recipient of the 1990 King Faisal International Prize in the Sciences (Chemistry)
Recipient of the 1990 Tolman Award of the Southern California Section of the American Chemical Society
Selected member of the Advisory Committee for Chemistry Division of NSF, 1990
The 1991 UCLA Faculty Research Lecturer for 1990-1991 *Recipient of the Harris Award, University of Nebraska, Lincoln, NE 1995*
Recipient of the 1997 American Chemical Society Award, Tennessee Section, 1997
Elected memberof the physical Society1998.
Recipient of the 1999 American Chemical Society Award, Florida Section, 1999
Recipient of the Richard Medal ofthe Northeast Section of the American Chemical Society,2000.
Recipient of the Langmuir Award in Chemical Physics of the American Chemical Society, 2001

The Georgia Tech 2007 Distinguished Professor of the year Award.
The 2007 USA National Medal of Science (Chemistry), 2008.
The Recepient of Honarary Doctors Degrees from: The Hebrew University, Israel (1980); the Mansoura Medical College, Egypt (2008); Alexandria University College of Medicine, Egypt (2008), Beny Swaif University, Benha University (2010) and Ain Shams University, 2013.
The Zewail prize in Moecular Sciences American Chemical Society (2009),
The Egyption Medal of the Republic of the First Class, 2009.
Selected to be among the top 100 most influential Persons in the State of Georgia, USA in 2011.
Selected to be among the 100 most influential Moslems in the state of Georgia, USA.in 2014.
On President Obama's USA National Medal of Science selection Committee (2014-2016).

Special Named Lectures

1. The Albert Noyes Visiting Lecture, University of Texas, Austin, Texas (1972)
2 The DuPont Lecture, Georgia Institute of Technology (1975)
3 Sierra Nevada Section Speaker, (American Chemical Society), University of Reno (1977)
4 The Industrial Users Lecture, California Institute of Technology (1978)
5 Bircher Lecture in Chemistry, Vanderbilt University (1980)
6 The Reilly Lecture, Notre Dame University (1981)
7 Distinguished Speaker Series, University of Utah (1982)
8 The Dreyfus Distinguished Visiting Scholar Lecture, Williams College (1982)
9 Joint Distinguished Lecture, Carnegie-Mellon University (1983)
10 Visiting Lecture Series, Columbia University (1983)
11 Mary E. Kapp Lecture, Virginia Commonwealth University (1984)
12 Arthur D. Little Lecture, Northeastern University, Boston (1984)
13 The Milton Kahn Lecture, University of New Mexico (1986)
14 The Randolph T. Major Lecture, University of Connecticut (1986)
15 The Kolthoff Lecture, University of Minnesota (1988)
16 Distinguished Summer Lecture Series, Northwestern University (1988)
17 Shell Chemistry Lecture, Florida State University, (1989)
18 The Chinese Academy of Sciences Distinguished Lecture Series (Taiwan) (1991)
19 The Edward Lee Lecture, University of California, Irvine (1991)
20 The 1991 Italian Academy of Science Speaker in Chemical Physics (1991)
21 The American Chemical Society Midwest Section/University of Wisconsin Physical Chemistry Colloquium. (1992)
22 Occidental Chemical Corporation Lecture, State University of New York, Buffalo (1992)
23 The Welch Foundation Lecture Tour (1993)

24 Charles A. Coulson Lecture Series, University of Georgia, Athens, GA (1994)
25 Advances in Chemical Physics Lecture, Rutgers, NJ (1995)
26 The Harris Lecture, University of Nebraska (1995)
27 The 1995 Boston College University lecture (1995)
28 Abbot Lecture, Northern Illinois University (1997)
29 Lind Lectures, Oak Ridge National Laboratory, Oak Ridge, TN (1997) and the University of Tennessee, Knoxville, TN (1997).
30 Frontier Lectures, Texas A&M (1997)
31 Annual Material Science Lecture, Material Sciences Dept, University of Pennsylvania (1997)
32 Nieuwland Lectures, Notre Dame University, South Bend, IN (1999)
33 Frontiers in Science Lecture, Florida Atlantic University, Boca Raton, FL (2000)
34 The Richard Medal Acceptance Speech, Harvard University, (2000)

35 Closs Lecture, University of Chicago (2000)
36 Weissberger/Williams Lecture Series, Eastman Kodak Co., Rochester, NY (2000)
37 The Foster Lecture, University of Buffalo (2000)
38 The H. Willard Davis Lecture, University of South Carolina (2000)
39 The Douglas G. Hill Memorial Lecture, Duke University (2001)
40 Lemieux Lecture, University of Ottawa, Canada (2002)
41 Eyring Lecture, Arizona State University (2004)
42 The Chancellor's Lecture, LSU (2005)
43 The Distinguished Lecture, Nanotechnology Center, UT, Austin (2005)
44 George B. Kistiakowsky Lecture, Harvard University, Cambridge, MA (2005)
45 E.U. Condon Lecture, Boulder, CO (2005)
46 2005 Frontiers in Nanotechnology Lecture, Northwestern University, Chicago, IL (2005)
47 The 2006 Pollak Lecture, The Technion, Haifa, Israel (2006)
48 The Zhong-Guan-Cun Forum on Condensed Matter Physics, Sept 17,2007 at the Institute of Physics, Chinese Academy of Science, Beijing, China.
49 The Wuhan Institute for Science and Technology Public Lecture, Sept 20, 2007, Wuhan, China
50 The Nanqiang Lecture, Xiamen University, Xiamen, China, Sept 26,2007
51 51The 2006 Pollack Lecture, The Technion, Haifa, Israel (2006)
52 The Zhong-Guan-Cun Forum on Condensed Matter Physics at the Institute of Physics, Chinese Academy of Science, Beijing, China (2007)
53 The Wuhan Institute for Science and Technology Public Lecture, Wuhan, China (2007)
54 The Nanqiang Lecture, Xiamen University, Xiamen, China (2007)
55 The Franklin Lecture, Rice University, Houston, TX (2008)
56 The 2012 G. N. Lewis Lecture, University of California, Berkeley (2012)
57. The Vanderbilt NanoCenter Chemistry Lecture (2013)
58. The Lord Spectroscopy Lecture MIT, (2014)

Regular Research Seminars at Research institutes and National meetings:

In the past 15 years, Professor El-Sayed gave one or two invited talks at Symposia at the two American Chemical Society annual Meetings.

Seminars Given Since Moving To Georgia Tech

2006 Valdosta State University; Valdosta, GA

University of Georgia; Athens, GA

University of Nebraska; Lincoln, NE

University of California; Irvine, CA

University of California; Los Angeles, CA

The Hong Kong University of Science and Technology; Kowloon, Hong Kong

Pierre-and-Marie-Curie University; Paris, France

University of Cairo; Cairo, Egypt

Wayne State University; Detroit, MI

Duke University; Durham, NC

Tel Aviv University; Tel Aviv, Israel

University of Cairo; Cairo, Egypt

2007 Mount Holyoke College; Boston, MA
Northwestern University; Evanston, IL
Stanford University; Stanford, CA
University of California; Berkeley, CA
Virginia Commonwealth University; Richmond, VA
University of Utah; Salt Lake City, UT
University of California; Santa Cruz, CA
The State University of New York at Buffalo; Buffalo, NY
Xiamen, China
Suzhou University; Shanghai, China
University of Oslo; Oslo, Norway

2008 Cairo University; Cairo, Egypt
University of Houston; Houston, TX
University of California; Los Angeles, CA
University of Manchester; Manchester, England
Huazhong University of Science and Technology; Wuhan, China
Changsha University; Changsha, China
Institute of Chemistry, Chinese Academy of Sciences; Beijing, China
Xiamen, China
Paris, France
Oslo, Norway
Copenhagen, Denmark

2009 Dubai, United Arab Emirates
University of Rhode Island; Kingston, RI
University of Cairo; Cairo, Egypt
University of Pennsylvania; Philadelphia, PA
Florida State University; Tallahassee, FL
University of Wisconsin; Madison, WI
California Institute of Technology; Pasadena, CA
Nile University; Giza, Egypt
Egyptian Petroleum Research Institute; Cairo, Egypt

2010 Texas Tech University; Lubbock, TX
University of Texas; San Antonio, TX
Pennsylvania State University; State College, PA
University of Akron; Akron, OH

University of Calgary; Calgary, Canada

Massachusetts Institute of Technology; Cambridge, MA

2011 Texas A&M University; College Station, TX

University of Buffalo; Buffalo, NY

American University of Beirut; Beirut, Lebanon

Case Western Reserve University; Cleveland, OH

University of Virginia; Charlottesville, VA

2012 American University of Cairo; Cairo, Egypt

Saudi Arabia: Taiba University,

Omelkorah University

Clemson University; Clemson, SC

University of Santiago de Compostela; Santiago, Spain

University of California; Berkeley, CA

Cairo, Egypt

2013 University of North Texas; Denton, TX

Stanford University; Stanford, CA

Kuwait University; Kuwait City, Kuwait

Columbia University; New York, NY

Northwestern University; Evanston, IL

McGill University; Montreal, Canada

University of Toronto; Toronto, Canada

University of Alabama; Tuscaloosa, AL

Purdue University; West Lafayette, IN

Kansas State University; Manhattan, KS

2014 Vanderbilt University: Nashville, TN

Ain Shams University, Cairo Egypt.

Georgia State University.

Massachusetts Institute of Technology; Cambridge, MA

University of Central Florida.

Plenary talk at the Faraday Discussions of the
Royal Society of England, Bristol, England.

Summary of Invited and Plenary Talks at National and International Meetings and Gordon Research Conferences And National Scientific Meetings :

~450 TALKS (up 2014)

TALKS AT RESEARCH INSTITUTES

A. Special Named Lectures (see above)

B. Regular Seminars OVER 210 SEMINARS

VI. RESEARCH ACTIVITIES

Research at the University of California at Los Angeles

(1961-1994)

1. The Radiative and Dynamic Properties of the Lowest Triplet State of Molecules:

Research on the triplet state of molecules has been very active during the past twenty years and pursued by optical and magnetic resonance spectroscopists as well as by photochemists and photobiologists. The contribution of our group towards an understanding of the radiative, nonradiative, magnetic and structural properties of the triplet state has been extremely valuable and extensive. We have applied known techniques as well as developed new ones to obtain new fundamental information concerning the properties of molecules in the different spin levels of the lowest triplet state of prototype molecules.

From the results on the polarization of phosphorescence, our group was the first to obtain detailed interaction schemes responsible for the previously known heavy atom effects on the phosphorescence properties. One of our papers was one of two that came out simultaneously introducing the method of "magnetophotoselection," now commonly used in triplet ESR research. In 1968, we began to develop the field of phosphorescence microwave double resonance. We showed how to use these techniques to determine the radiative, nonradiative, magnetic and structural properties of molecules in the different spin levels of the lowest triplet state. Most notably is our work in which we used the spin label of triplet molecules to determine the mechanism of the nonradiative electronic energy relaxation process from the lowest excited singlet state to the lowest triplet state. We showed that the effect of small magnetic field on the net spin polarization of the system at low temperature enables the determination of the mechanism of this important nonradiative process. We then applied this new valuable technique to elucidate the mechanism in a number of important systems. In N-heterocyclic systems, the results are found to be consistent with the selection rules we proposed over ten years earlier (The El-Sayed's Rule: **Wikipedia, the free encyclopedia)** Using Stark effect on the double resonance signal, we were the first to measure and account for the difference in the dipole moment of some polar molecules in the different spin levels of the lowest triplet state. Using double resonance methods, we were the first to show that in some solid-state photochemistry, the reactivity of molecules in different spin levels of the lowest triplet state can be different.

2.Lasers and Molecular Dynamics:

During the past ten years, our group has been successful in using the different properties of lasers to develop new techniques and to study intraand inter-molecular dynamics in different systems, ranging from isolated gas molecules to the photosynthetic system of bacteriorhodopsin. Below a summary of the important contributions made during the past few years is given:

a.Multiphoton Ionization and Dissociation Spectroscopy:

Our group was among the first two groups to use two-color lasers and ionization detection to measure the lifetime of excited states and the ionization potential of molecules. In two-photon-multiphoton ionization spectroscopy, our group was the first to use polarization techniques in assigning two photon transitions of large polyatomic molecules. This technique was then applied to identify the type of the electron (p\ vs. nonbonding) having the lowest ionization potential in heterocyclic compounds.

In laser multiphoton ionization-dissociation, a technique was developed to differentiate between mechanisms involving ionization followed by dissociation and those involving dissociation followed by ionization. In this technique two-color lasers are used and the time-of-flight mass spectrum is studied as a function of the repelling voltage applied in the ionization-extraction zone.

Recently, by combining two-color picosecond laser techniques with mass spectrometry, our group was able to determine the rates of energy redistribution prior to ionic fragmentation in mass spectrometry. This technique makes it potentially more profitable to study energy redistribution in ions than in neutral species. In addition, it offers an experimental method to test the applicability of the quasi-equilibrium theory proposed in 1944 to describe the observed mass spectra of molecules.

b.Switching of Energy Transfer Mechanism with Distance in Disordered Solids:

Using time-resolved laser luminescence line narrowing (LLN) techniques, the mechanisms of energy transfer between the same chemical species in different sites have been investigated in disordered solids. In pure solids with large inhomogeneous linewidth, it was shown that by changing the wavelength of the existing laser, the average donor-acceptor distance can be changed continuously if the energy transfer studies are carried out at 1.6\K. Using this technique, a careful distance dependence of the energy transfer mechanism in some of these solids at low temperature has been investigated. Our group was the first to demonstrate switching in an energy transfer mechanism with distance. Thus while triplet-triplet energy transfer occurs via an electron-exchange mechanism at short distances for 1-chloro-4-bromo-naphthalene solid at 1.6 K, a dipole-dipole mechanism dominates at distances larger than ~10.

3,Time-Resolved Raman Spectroscopy:

Our group has developed a number of techniques that enabled the determination of the resonance Raman spectra of transients formed in the milli-, micro-, nano-, and picosecond time domains. In each time regime, a different type of lasers (c.w. or pulsed) or a different technique of sample excitation (static vs. sample flow technique) was used. In the different techniques, the time resolution is limited by either the laser pulse width or by the focal volume and the sample flow rates. Using the microbeam flow technique with picosecond lasers, our group was the first to report the resonance Raman spectrum of a picosecond transient.

The above techniques were developed in order to answer important questions about the mechanism of some photobiological changes. Bacteriorhodopsin, the second photosynthetic system in nature besides chlorophyll, was one of two systems studied with the time-resolved

resonance Raman technique that we have developed. We were the first to show clearly that retinal conformational changes indeed occur in a time shorter than 50 ps. We have also shown that, unlike chlorophyll, intermolecular energy transfer does not take place in bacteriorhodopsin prior to photochemical changes, i.e., the absorption and the primary photochemical reaction (configuration) changes occur on the same molecule. In combination with optical time-resolved studies, the nature of the coupling between the retinal and the protein is examined.

4.Rate of Energy Redistribution in the Transition State

We have developed a simple technique using nanosecond pulsed lasers and a home built time of flight mass spectrometer to determine the rate of energy redistribution in molecules falling apart on the subpico-to-picosecond time scale. This is also the time scale for molecular rotation of some molecules. For these systems, an excited ensemble will have a distribution of lifetimes. The ones that dissociate immediately will have no time to redistribute any excess energy above bond dissociation into internal energy. The fragments will be anisotropically distributed and should have large recoil translation energy. Molecules that have time to rotate, before dissociation, will give fragments in different direction than those produced from rapid dissociation and will also have less recoil energies (as some of the excess energy is redistributed in internal energy during the time it takes the molecule to rotate). Thus by measuring the recoil energy of fragments detected along the laser polarization direction and perpendicular to it, the amount of energy that redistributes in a quarter of a rotation can be determined. In the actual experiment, the polarization ratio of the signal intensity of the fragments at different recoil velocity is determined and is related to the time dependent correlation function, from which the time dependence of the recoil velocity (and thus of the recoil translation energy) is determined. From the slope, the rate of energy redistribution is determined.

The dependence of the rate of energy redistribution on the excited state structure of different molecules is examined. For smaller molecules (e.g. ICN, HgI_2,) the dependence of this rate on the calculated potential energy surfaces and the effect of curve crossing is being studied.

5.The Structure and Stability of Mixed Gaseous Clusters

Metallic-Ionic Mixed Clusters:

The evaporation dynamics of $(Ag_x)^+$ clusters in which different number of Ag atoms are changed into AgI molecules are examined. Questions like how does the binding of an AgI polar molecule to the $Ag^+_{(x-1)}$ cluster depends on its polarizability is to be answered. In addition, in clusters with more than one AgI molecule, do the polar molecules stay together or spread around the metallic part of the cluster? Do we get phase separation. What fraction of the Ag atom needs to be converted into AgI before phase separation between the metallic and the ionic part of the cluster occurs? Both theoretical and experimental studies are being carried on in order to understand this interesting system.

Mixed Ionic Clusters:

How much a cluster like $[Cs(CsI)_{14}]^+$ is destabilized by introducing defects created by substituting one or more of the CsI molecules with another alkali halide molecules of different size (e.g. in $[Cs(CsI)_{13} \lozenge RbI]^+$? By studying the evaporation dynamics of the mixed cluster one can determine its relative rates of evaporation to give CsI or RbI from the relative mass peak

intensity of the corresponding daughter ions. By assuming the absence of barriers for the condensation process (which involves ion-dipole interaction), one can deduce from the kinetic data thermodynamic quantities from which the effect of impurity (RbI) substitution on the stability of the parent cluster can be determined. Furthermore, the energy difference between different "isomers" (resulting from the different sites that the RbI molecule(s) can occupy) can be determined. Using a modified polarizable electrostatic model of Martin et al., one can calculate the internal energies of these mixed clusters, as is done for pure clusters. A careful test of the model can be accomplished by calculating these small energy differences and comparing them to experiments.

Coulombic Explosion in Cluster Dications

Using Mass spectrometric techniques, the stability of dication metallic clusters is examined. The critical cluster size below which the cluster is unstable towards Coulombic explosion will be determined for different metal dication clusters. The effect of adding different atoms, e.g., halogens, on the stability of present clusters will be examined. Theoretical predictions of the critical size will be tested and more understanding of the cluster structures and the mechanism of their explosion will be accomplished.

6.The Molecular Mechanisms of the Proton Pump in the Photosynthesis of Bacteriorhodopsin (bR)

The Protein Catalysis of the Retinal Photoisomerization

Bacteriorhodopsin, a retinal protein membrane present in halobacterium halobium, is the other photosynthetic system in nature besides chlorophyll. Upon the absorption of light, it rapidly isomerizes leading to charge separation. The system then goes through a photocycle with a minimum of six intermediates before it returns to its original state. As a result, protons are pumped from inside the cell to the membrane surface, thus converting solar to electric energy, which is used in ATP synthesis.

We, and others have shown that the primary process in bR photocycle is indeed a retinal photoisomerization. It occurs extremely rapidly on the 0.5 ps time scale and only around the C_{13} - C_{14} bond. In solution, this process occurs on the nanosecond time scale and is not so highly specific. The question immediately arises regarding the molecular mechanism(s) by which the protein catalyzes this process and makes it so highly specific in bR (as well in rhodopsin).

In order to answer these questions, we are involved in two types of studies. In one, the rate of retinal isomerization of a number of mutants in which individual charged or hydrogen bonding amino acids are genetically replaced by nonhydrogen bonding neutral ones. This work is done in collaboration with Professor J. Lanyi of U.C. Irvine who prepares the different mutants.

In the second type of studies, the somerization of bound modified retinals (synthesized by Professor R. Liu of the University of Hawaii) are measured. The aim of these studies is to separate the effect of electrostatic interactions from the indirect sterric effects within the cavity as a factor in the catalyses and the specificity of the protein to the photoisomerization process.

Metal Cation Role in the Proton Pump Function of bR

The removal of metal cations from bR inhibits the proton pumping function. The question thus arises as to their role in making the molecular pump work.

A detailed study of the binding sites of the metal cations is underway. The importance of negatively charged amino acids (aspartates and glutamates) and hydrogen bonding residues to the binding is examined by a systematic genetic replacement of each of the important ones and examining the effect on the value of the binding constants of the different sites.

After the binding characteristic is understood, the effect of metal cation on the dynamical structuralproperties will begin. In these studies, an examination of the effect of binding of metal cations on the FTIR spectrum of bacterio-opsin and its mutants will be examined. In this manner, the amino acids most directly affected by the binding could be identified. A detailed examination of the effect of different metal cations on the energy and entropy of activation of both the deprotonation process as well as the proton transport process to the surface will be carried out. The latter will be extracted from the temperature dependence of the change of color of pH sensitive dyes attached to an amino acid at the opening of the proton chanel.

A final determination of the location of metal cations in bR could be made by use of anamolous x-ray scattering in Brookhaven National Lab. In this work, metal cations whose K or L resonances are in the x-ray wavelength range taken of BNL synchrotron facility will be used. By subtracting the diffraction pattern obtained off from that on resonance only the scattering from the metal cations will be determined. If we do this experiment as one gradually fills in the different sites, it is hoped that the location of the different binding sites can be determined from the two dimensional projection map obtained from these studies. The results of the FTIR studies should be helpful in this complex effort.

B. *RESEARCH CARRIED OUT AT THE GEORGIA INSTITUTE OF TECHNOLOGY,(1994-*

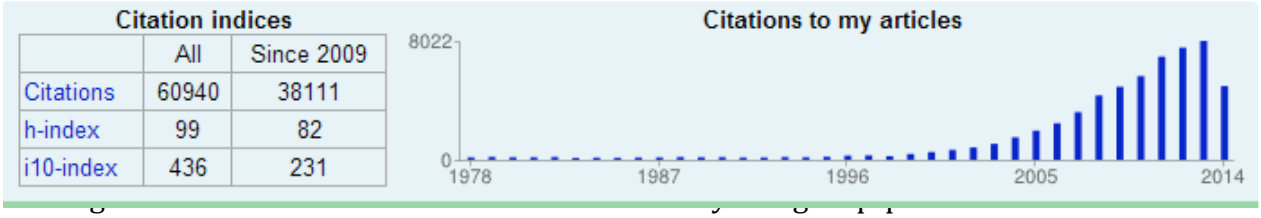
The following research projects are carried out in the Laser Dynamics Laboratory (LDL) directed by Professor El-Sayed (http://ldl.gatech.edu). LDL houses the most recent lasers and laser spectroscopic equipment for time resolved optical, Raman and IR studies. It also houses biochemical labs equipped with cell culture facilities, modern facilities of plasmonic imaging in time the single cells and their contents using either SERS spectra or Rayleigh images during the cell full life (between birth to division) or as it dies. Available for LDL researchers the use of the Georgia Tech clean room facilities with its High resolution TEM, electron-beam facilities for the synthesis of nanoparticles of different shapes, and its high resolution structural determination facilities.

The present research interests are focused on the synthesis, the determination of the structure and the properties of materials (semiconductor and metallic nanoparticles) of sizes confined to the nanoscale (between one and 100 nm). Applications in different technical fields ranging from nanpcatalysis, nanosensors to cancer nano medicine and moleculat cell-biology were developped and used.

Contributions to Nanoscience and Nanotechnology:

INTRODUCTION

Over the past twenty years, El-Sayed and his group have made unparalleled contributions to the fields of nanoscience and nanotechnology . Figure1 below (taken in July of 2014 from Google Scholar citation): http://scholar.google.com/citations?user=BMpDLscAAAAJ&hl=en) shows the dramatic change in the annual number of citations with time of the published papers by his group before and after changing his research activity to the nanoscience field (in the mid-ninety). It also shows the large change in his h-index in the last five years, when the impact of focusing his nano-science research on nano-medicine and cancer research (the developing different techniques using gold and silver nanoparticles in the diagnosis, therapy and studying on single cell of cancer).



Citation indices

	All	Since 2009
Citations	60940	38111
h-index	99	82
i10-index	436	231

after getting into the nanoscience research in the late nineties until mid of 2014 (Scholar.google.com/citations).

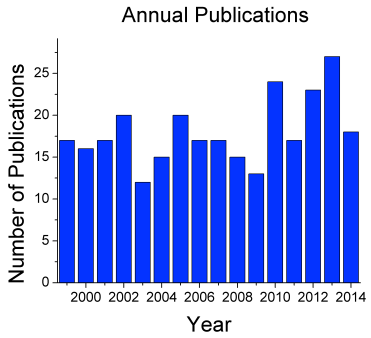


Fig 2.El-Sayed's group annual publications in the nanoscience research field until mid July of 2014.

He and his group have published more than 670 articles total by the mid of 2014 with half of this appeard in the last twenty years (The number of citations per paper published in the past few years has been in the hundreds (See the large exponential increase in the citations to his research papers in this period in fig1 and the number of published papers in fig 2).

LDL research laboratory has been consistently ranked among the top chemical research laboratories in the world during the last decade (#4 among Academic laboratories according to the Times Higher Education and #17, among Academic, national, international and industrial laboratories as concluded by Thomson-Reuters: Refer to his website: http://ldl.gatech.edu). Figure 2 also shows the large

increase in the # of his annual published papers reached 27 papers in 2013 and extrapolated to over 30 papers in 2014. It is this excellent scientific creative performance as well as the research field that El-Sayed selected to do his reasearch that were responsible for crowning him with the **highest national honor** a scientist in the USA can receive, this is the USA National Medal of Science (in chemistry) :nanoscience: nanocatalysis, and nanomedicine (please go to: http://ldl.gatech.edu.)

Early studies in LDL in this field included the unique optical and photo-thermal properties of gold and silver nanoparticles of different and discussed the potential use could be used to more easily Nano-science (e.g. in1,2,3,4,5,6) that lead to the rapid development of this important field and some of its potential applications in the field of nanotechnology, e.g. in catalysis, in sensors and in the important field of medicine. This is the reason for the very high citations to his work. During the past five years alone, LDL publications have received 37,880 citations. : http://scholar.google.com/citations?user=BMpDLscAAAAJ&hl=en

On Jan. 29, 2010 - the Laser Dynamics Laboratory (LDL) (see http://ldl.gatech.edu/), whose director is Professor El-Sayed, was ranked #4 Worldwide among Academic chemistry research labs of the past decade by the Times Higher Education. LDL publications garnered an impressive 75.74 citations per paper over this period. On March 21, 2011, the Laser Dynamics Laboratory was ranked #17 worldwide among all chemistry research labs (Academic, National as well as the Industrial labs) during the past decade (2000-2010) by the Thomson Reuters. During this period. LDL published more highly cited manuscripts than any others in the top 20.

Below we will describe some of the LDL to nanoscience and its important impact on technology. Three fields this group has studied and obseved new nano-scientific properties with some are shown to have important impact on the field of Nanotechnology.

References:

1. C Burda, X Chen, R Narayanan, MA El-Sayed, Chemistry and properties of nanocrystals of different shapes, Chemical reviews 105 (4), 1025-1102, 2005 (invited, 4400 citations)
2. S Link, MA El-Sayed, Spectral properties and relaxation dynamics of surface plasmon electronic oscillations in gold and silver nanodots and nanorods,, The Journal of Physical Chemistry B 103 (40), 8410-8426 (1999) (Invited, 2507 citations)
3.MA El-Sayed, Some interesting properties of metals confined in time and nanometer space of different shapes, Accounts of Chemical Research 34 (4), 257-264,2001 INVITED (2080 citations).
4. .S Link, MA El-Sayed, Shape and size dependence of radiative, non-radiative and

photothermal properties of gold nanocrystals, International Reviews in Physical Chemistry 19 (3), 409-453 (Invited, 1330 citations)
5. Shape-controlled synthesis of colloidal platinum nanoparticles, TS Ahmadi, ZL Wang, TC Green, A Henglein, MA El-Sayed, SCIENCE-1924-1925, 1996 (2013 citations).
6. P. K. Jain, X. H. Huang, I. H. El-Sayed and M. A. El-Sayed. (2008) Noble Metals on the Nanoscale: Optical and Photothermal Properties and Some Applications in Imaging, Sensing, Biology, and Medicine. Accounts of Chemical Research 41, 1578-1586. (Invited, 1221 citations)
7. IH El-Sayed, X Huang, MA El-Sayed, Surface plasmon resonance scattering and absorption of anti-EGFR antibody conjugated gold nanoparticles in cancer diagnostics: applications in oral cancer,Nano letters (5), 829-834, (1120 citations, The most cited paper in the Journal of the American Chemical Society in the whole year)

We shall give short account of the contributions of El-Sayed and his group to the different studies and applications they made to the three different fields of the nanscience; nanocatalysis, nanosensors and nanomedicine.

1.NanoScience: The new Properties of Material Confined in Time and Space of Different Shapes:

The type of electronic motion in matter determines its property and thus its uses in our everyday life.This motion itself is determined by the forces acting on the electrons and thus the space in which they are allowed to move. The difference between a metal, a semiconductor and an insulator lies in the fact that the electronic motion is highly delocalized, slightly confined, and highly confined, respectively. One thus expects that if we reduce the size of material to below its naturally allowed characteristic length scale new properties should be observed which are different from that of the macroscopic material as well as of their building blocks (atoms or molecules). This size is on the nanometer length scale.

a.Ultrafast Electron-Hole Dynamics in Semiconductor Nanoparticles

The type of electronic motion in matter determines its property and thus its uses in our everyday life. This motion itself is determined by the forces acting on the electrons and thus the space in which they are allowed to move. The difference between a metal, a semiconductor and an insulator lies in the fact that the electronic motion is highly delocalized, slightly confined, and highly confined, respectively. One thus expects that if we reduce the size of material to below its naturally allowed characteristic length scale new properties should be observed which are different from that of the macroscopic material as well as of their building blocks (atoms or molecules). This size is on the nanometer length scale.

b.Shape Controlled Synthesis, Stability and Self Assembly of Metallic

Nanoparticles

Different methods are developed to synthesize, reshape and study the self-assembly characteristics of gold, silver and transition metal nanoparticles. High resolution TEM is used to follow the shape distribution and their dependence on the preparation condition and to study their thermal stability. From the results, themechanism of shape controlled growth and self-assembly are elucidated.

c,Photothermal Stability of Metallic Nanoparticles

Metallic nanoparticles of non-spherical shape have been found to undergo a sharp transformation into the more thermodynamically stable spherical shape induced by pulsed laser excitation. A study is directed to understand mechanism and relevant time scales involved in this photothermal shape transformation. By adjusting the power and wavelength of the pulsed laser, the size and shape distribution of non-spherical nanoparticles can be changed and the nanoparticles can be reshaped.

d.Optical and Nonradiative Properties of Assembled Metallic Nanoparticles

Three methods are used for the assembly of metallic nanoparticles: 1) From colloidal solution of highly mono-dispersed sample, 2) Nanosphere lithography, and 3) Electron beam Lithography. Metallic nanoparticles assembled in monolayer periodic arrays present opportunities to study both unique properties of individual nanoparticle and collective properties of coupled nanoparticles. The current fundamental research in the Laser Dynamics Laboratory on metallic nanoparticle arrays includes: 1) Ultrafast dynamics of coherent vibration induced by femtosecond laser; 2) Effects of electronic coupling between nanoparticles on the optical and electronic properties; 3) Medium effects on electron-phonon and phonon-phonon dynamics. 4) The laser photothermal heating of gold and silver nanoparticles can result in the heating or melting of the medium surrounding the nanoparticle. Alternately, the nanoparticles may themselves melt or atomic ablation may take place. We are studying the dependence of the nature of photothermal heating of gold and silver nanoparticles on the rate of heat deposition by varying the photothermal laser pulse energy and the pulse duration as well as the effect of cw laser on photo-thermal destruction of cancer cells.

The current fundamental research in the Laser Dynamics Laboratory on metallic nanoparticle arrays includes:

Ultrafast dynamics of coherent vibration induced by femtosecond laser

Effects of electronic coupling between nanoparticles on the optical and electronic properties.

Medium effects on electron-phonon and phonon-phonon dynamics.

The laser photothermal heating of gold and silver nanoparticles can result in the heating nanoparticles may themselves melt or atomic ablation may take place. We are studying the dependence of the nature of photothermal heating of gold and silver nanoparticles on the rate of heat deposition by varying the photothermal laser pulse energy and the pulse durationon biological cell for

possible cancer cell treatment.

2. NanoTechnology: Potential Applications of Nanoparticles

a. Applications in Nanocatalysis:

Nanoparticles are potentially attractive catalysts since they have a large surface-to-volume ratio and high surface energy compared to bulk catalytic materials. In addition, metal nanoparticles of different shapes have different crystallographic facets and different fraction of atoms located on their corners and edges, which makes it interesting to study the effect of nanoparticle shape on the catalytic activity of various reactions. It is also important to note that having very active surface atoms could make the nanoparticles unstable during the course of its catalytic function. In the case of the early stages of the electron transfer reaction, we found that tetrahedral platinum nanoparticles are the most catalytically active and have the greatest fraction of surface atoms on their corners and edges, while the cubic platinum nanoparticles are the least catalytically active and have the lowest fraction of surface atoms on their corners and edges. During the full course of the reaction (2 days), it is observed that distortions in the corners and edges of both the tetrahedral and cubic platinum nanoparticles take place. In addition, the rate of dissolution of corner and edge atoms is found to be faster for the tetrahedral nanoparticles.Shape dependence of the catalytic rate on the fraction of atom on corners and edges observed at the early stage of catalytic electron transition reactionRadha Narayanan and Mostafa A. El-Sayed, Nano Letters, 2004, 4(7), 1343-1348; Radha Narayanan and Mostafa A. El-Sayed, Journal of the American Chemical Society, 126(23), 7194-7195 (2004).)As the catalytic reaction continues in colloidal solution, shape changes take place eliminating sharp edges and corners (to eventually make spherical shape).Radha Narayanan and Mostafa A. El-Sayed, Journal of Physical Chemistry B, 2004, 108(18), 5726-5733; Radha Narayanan and Mostafa A. El-Sayed, Journal of the American Chemical Society, 125(27), 8340-8347 (2005).
heating or melting of the medium surrounding the nanoparticle.
The sharp corners and edges are valency unsatisfied (surrounded with lower number of bonded atoms compared with the atoms on the faces) which increases their chemical activity. Nanocatalysts of different shapes with sharp corners and tips have been prepared and examined in catalysis such as cubes[2], tetrahedral[2], and multi-armed stars[6]. Although such unique design introduced an exciting catalytic

Noble metallic nanoparticles such as palladium and platinum are widely used in catalysis, due to their high catalytic efficiency for many chemical and electrochemical reactions.[1] Different shapes of the metallic nanocatalysts have been prepared with different designs.(2,4) The main goal of controlling the design of the nanocatalysts is to increase their catalytic efficiency, which reduces the production cost; one of these designs is to introduce sharp corners and edges in the shapes of the nanocatalysts.5 However, the atoms in the sharp corners and edges are valency unsatisfied (surrounded with lower number of bonded atoms compared with the atoms on the faces) which increases their chemical activity(6). Nanocatalysts of different shapes with sharp corners

and tips have been prepared and examined in catalysis such as cubes[2], tetrahedral[2], and multi-armed stars[6]. Although such unique design introduced an exciting catalytic efficiency for such shapes, possible rounding of the corners and the edges during the catalysis is a serious challenge that has not been resolved In order to resolve the reshaping challenge in using sharp corners and edges nanocatalysts, we have designed the nanocatalysts to be of hollow structure[9-11] Nanocatalysts of hollow design presented an excellent catalytic efficiencywhich based on the confinement of the reactive species either intermediates or reactants inside the hollow nanocatalysts during the catalysis, this confinement increases the collision probability with the surface of catalyst and enhances the efficiency of the catalysis reaction[9] Hollow nanostructures of different designs have been prepared of single shell and showed high catalytic efficiency such as gold[9], platinum[3], palladium[4] and double shells[3] such as platinum-palladium, gold-palladium[9], and gold-platinum[10]

In order to understand the relationship between the photo-catalytic efficiency of a semiconductor and electron-hole charge separation on the nanoscale, we have used the femtosecond pump-probe technique to study the excited electronic state decay dynamics in Cu_2O nano-shell coating gold nanoframes[11]. The lifetime of the electron decay of Cu_2O of different thickness around the gold nanoframes were compared with their photocatalytic efficiency[12]

References:

1.TS Ahmadi, ZL Wang, TC Green, A Henglein, MA El-Sayed, Shape-controlled synthesis of colloidal platinum nanoparticles, , SCIENCE, 1924-1925,1996 (2006 citations).

2. Mahmoud A Mahmoud , Narayanan, R.; El-Sayed, M. A., Enhancing Colloidal Metallic Nanocatalysis: Sharp Edges and Corners for Solid Nanoparticles and Cage Effect for Hollow Ones, Acc Chem Res, (2013).A , Acc Chem Res. ,46, 1795-805.2013.

3. Li, Y.; Hong, X. M.; Collard, D. M.; El-Sayed, M. A. Suzuki Cross-Coupling Reactions Catalyzed by Palladium Nanoparticles in Aqueous Solution. Organic Letters 2000, 2, 2385-2388.

4. Mahmoud, M. A.; Saira, F.; El-Sayed, M. A. Experimental evidence for the nanocage effect in catalysis with hollow nanoparticles. Nano letters 2010, 10, 3764-3769.

5. Burda, C.; Chen, X. B.; Narayanan, R.; El-Sayed, M. A. Chemistry and properties of nanocrystals of different shapes. Chemical Reviews 2005, 105, 1025-1102.

6. Narayanan, R.; El-Sayed, M. A. Shape-Dependent Catalytic Activity of Platinum Nanoparticles in Colloidal Solution. Nano Letters 2004, 4, 1343-1348.

7. Mahmoud, M. A.; Tabor, C. E.; El-Sayed, M. A.; Ding, Y.; Wang, Z. L. A new catalytically active colloidal platinum nanocatalyst: the multiarmed nanostar single crystal. Journal of the American Chemical Society 2008, 130, 4590-4591.

8. Narayanan, R.; El-Sayed, M. A. Changing Catalytic Activity during Colloidal Platinum Nanocatalysis Due to Shape Changes: Electron-Transfer Reaction. Journal of the American Chemical Society 2004, 126, 7194-7195.

9. Mahmoud, M. A.; Narayanan, R.; El-Sayed, M. A. Enhancing colloidal metallic nanocatalysis: sharp edges and corners for solid nanoparticles and cage effect for hollow ones. Accounts of chemical research 2013, 46, 1795-1805.

10. Mahmoud, M. A.; El-Sayed, M. A. Time dependence and signs of the shift of the surface plasmon resonance frequency in nanocages elucidate the nanocatalysis mechanism in hollow nanoparticles. Nano letters 2011, 11, 946-953.
11. Yen, C. W.; Mahmoud, M. A.; El-Sayed, M. A. Photocatalysis in Gold Nanocage Nanoreactors†. The Journal of Physical Chemistry A 2009, 113, 4340-4345.
12. Mahmoud, M. A.; Qian, W.; El-Sayed, M. A. Following Charge Separation on the Nanoscale in Cu2O–Au Nanoframe Hollow Nanoparticles. Nano letters 2011, 11, 3285-3289.

B. Applications in Nanophotonics

When photons interact with nanoscale materials (semiconductor and metal), many new physical phenomena will be observed which are not present in corresponding bulk materials. Nanophotonics provides opportunities for making ultra-small optoelectronic devices which have great performance in lasing, sensing, and communication. In our group, we have made two-dimensional metallic nanoprism arrays with well-defined size, shape, and interparticle separation using nanosphere lithography technique. These samples could be used in surface-enhanced spectroscopy, plasmonic devices, and sensors due to its tunable optical properties. We have observed modulation of the color of plasmonic nanoparticles with coherent lattice vibration due to the dependence of the surface plasmon frequency on lattice volume change with the modulation period proportional to the size of nanoparticle. SEM images (Left) of the prismatic silver (a-c) and gold (d-f) nanoparticles monolayer arrays (in white color) made with nanosphere lithograph technique and the absorption spectra (Right) of the silver (a) and gold (b) periodic array samples made with the 0.26 (blue spectrum), 0.36 (green spectrum) and 0.45 μm (red spectrum) PS spheres, respectively.Expected dependence of surface plasmon absorption spectra on volume during the lattice oscillation of a gold or silver nanoparticle.Optically detected lattice phonon oscillations induced in the prismatic Ag (a,b,c) and Au (d,e,f) nanoparticles monolayer arrays with a 100 fs laser pulse at 400 nm and monitored near the absorption maximum of each nanoparticle (solid dots). The size (bisector) of the silver nanoparticles is around (a) 52.4, (b) 79.6 and (c) 99.3 nm. The size of the Au nanoparticles is around (d) 60.5, (e) 85.7 and (f) 103.7 nm.Wenyu Huang, Wei Qian and Mostafa A. El-Sayed , Nano Letters, 2004, 4 (9), 1741-1747; Wenyu Huang, Wei Qian and Mostafa A. El-Sayed , The Journal of Physical Chemistry B, 2005, 109 (40), 18881-18887.

C. Contributions to the field of Nano-Sensors:

Plasmonic nanoparticles are characterizedby having the localized surface plasmon resonance (LSPR) spectrum and possessing strong surface electromagnetic plasmonic field. The peak position of LSPR spectrum of any plasmonic nanoparticles depends on the dielectric of the surrounding medium in addition to other physical parameters. The plasmonic field greatly enhances the Raman signal by a factor of over 10^{10} times. Both the shift of the LSPR peak position upon changing the dielectric function of the

surrounding medium and the enhancement of the Raman signal by the plasmonic field are used in the chemical and biological sensing technology. Recently, we have prepared plasmonic nanoparticles of different structures such as gold nanoframes[1] which when used in sensing showed very high efficiency[2]. These gold nanoframes were used successfully to detect the Raman signal of toxic gases of low concentrations down to the zeptomolar level.[1] The unique efficiency of such nanoparticles is attributed to the presence of two types of plasmonic surfaces; one on the exterior surface of the particle and the other is on the interior surface of the cavity.[3] The coupling between these two surface fields makes the LSPR peak position of these nanoparticles tunable in the visible and NIR regions.[3] In order to make the plasmonic nanoparticles prepared by the colloidal chemical technique more applicable in sensing, we were able to assemble them into monolayer on the surface of substrate.[4] The effect of substrate on the sensing efficiency of the plasmonic nanoparticles was discussed in our recent studies.[5,6] TheLSPR phenomenon is clearly sensitive to the nanoparticle shape of gold and silver nanostructure. We compared the sensing efficiency of nanoparticles made of gold and silver nanorods.[7]

References

1 Mahmoud, M. A. & El-Sayed, M. A. Aggregation of gold nanoframes reduces, rather than enhances, SERS efficiency due to the trade-off of the inter-and intraparticle plasmonic fields. Nano letters 9, 3025-3031 (2009).

2 Mahmoud, M. A. & El-Sayed, M. A. Gold nanoframes: Very high surface plasmon fields and excellent near-infrared sensors. Journal of the American Chemical Society 132, 12704-12710 (2010).

3 Mahmoud, M. A., Snyder, B. & El-Sayed, M. A. Surface Plasmon Fields and Coupling in the Hollow Gold Nanoparticles and Surface-Enhanced Raman Spectroscopy. Theory and Experiment†. The Journal of Physical Chemistry C 114, 7436-7443 (2010).

4 Mahmoud, M. A., O'Neil, D. & El-Sayed, M. A. Hollow and Solid Metallic Nanoparticles in Sensing and in Nanocatalysis. Chemistry of Materials 26, 44-58, doi:10.1021/cm4020892 (2013).

5 Mahmoud, M. A., Chamanzar, M., Adibi, A. & El-Sayed, M. A. Effect of the Dielectric Constant of the Surrounding Medium and the Substrate on the Surface Plasmon Resonance Spectrum and Sensitivity Factors of Highly Symmetric Systems: Silver Nanocubes. Journal of the American Chemical Society 134, 6434-6442 (2012).

6 Mahmoud, M. A. & El-Sayed, M. A. Substrate Effect on the Plasmonic Sensing Ability of Hollow Nanoparticles of Different Shapes. The Journal of Physical Chemistry B 117, 4468-4477 (2013).

7 Mahmoud, M. A. & El-Sayed, M. A. Different plasmon sensing behavior of silver and gold nanorods. The Journal of Physical Chemistry Letters 4, 1541-1545 (2013).

Contributions to the field of Medicine (Nanomedicine):

a. Introduction:

The most useful and important contributions of El-Sayed's group to nanoscience that best impacted Nanotechnology is indeed to the field of medicine and molecular cell biology. Their early results on the plasmonic properties of gold and silver nanoparticles [1,2,3,4] enabled them to use what they found to develop methods for cancer diagnostic [5] and photothermal therapy [6]. In order to use the property of gold nanoparticles in photothermal therapy in which moderately strong light is absorbed, converted into intense scattered light used in imaging applications or some of it is converted into high temperature heat used in the photo-thermal selective destruction of the cancer or any diseased cells. Only near infra-red light can penetrate long distances in the human body. Nanorods are known to absorb in the near IR at different wavelengths depending on the rods aspect ratios. We developed [7] the best synthetic method to make the nanorods. This method is now the most used method for making the nanorod for use in photothermal and many other photonic applications Worldwide. This synthetic publication has won the most cited and most downloaded paper of the American Chemical society "Chemistry of mateial" journal every year for the past six years.

El-Sayed received five years funding from the National institute of Health (NIH) to use the gold nanorods in photo-thermal cancer therapy in animal studies jointly with the assistant director of the Winship Cancer Institute of Emory University Medical School in Atlanta. In addition, El-Sayed is directing a30-scientists research group at the Egyptian Research Center in Cairo, Egypt, funded by an Islamic group (Misr El-kheir) using the Zakah funds collected to help good causes for suffering people in Egypt, like those fighting cancer. These two studies are now in progress in Egypt and in the United States.

In another direction, the El-Sayed group has developed a spectroscopic technique making use of the strong imaging power of the enhanced scattering properties of gold or silver nanoparticles to image single cell behavior (using enhanced Rayleigh type scattering) or the molecular changes anywhere in a live single cell (using Surface Enhanced Raman Scattering, SERS and specific conjugation techniques). More important, these studies can be carried out in time during the cell lifetime, during its division or as the cell dies[8] from any disease or as it is treated with any Cancer drug .

References:

1 S Link, MA El-Sayed, Spectral properties and relaxation dynamics of surface plasmon electronic oscillations in gold and silver nanodots and nanorods,, The Journal of Physical Chemistry B 103 (40), 8410-8426 (1999) (Invited, 2507 citations)
2.MA El-Sayed, Some interesting properties of metals confined in time and nanometer space of different shapes, Accounts of Chemical Research 34 (4), 257-264,2001 INVITED (2080 citations).
3. .S Link, MA El-Sayed, Shape and size dependence of radiative, non-radiative and photothermal properties of gold nanocrystals, International Reviews in Physical Chemistry 19 (3), 409-453 (Invited, 1330 citations)
4. PK Jain, KS Lee, IH El-Sayed, MA El-Sayed, Calculated absorption and scattering properties of gold nanoparticles of different size, shape, and composition: applications in biological imaging and biomedicine,The Journal of Physical Chemistry B 110 (14), 7238-7248(2006), 1458 citations

5. El-Sayed, Ivan; Huang, Xiaohua; El-Sayed, Mostafa A., "Surface Plasmon Resonance Scattering and Absorption of anti-EGFR Antibody Conjugated Gold Nanoparticles in Cancer Diagnostics; Applications in Oral Cancer," Nano Letters 4 (5), 829-834, (2005).
6. Huang, X., El-Sayed, I. H., Qian, W. and El-Sayed, M. A. "Cancer Cell Imaging and Photothermal Therapy in the Near-Infrared Region by Using Gold Nanorods," Journal of the American Chemical Society, 128 (6), 2115-2120, (2006).
***(MOST CITED 2006 JACS ARTICLE !!! - as of Mar 31, 2008)
7. Preparation and growth mechanism of gold nanorods (NRs) using seed-mediated growth method, Nikoobakht, MA El-Sayed Chemistry of Materials 15 (10), 1957-1962 **(the most cited and downloaded paper in the ACS Chemistry of Materials Journal for the past several years).**
8.B.Kang,L.A,Austinand M.A.El-Sayed. (2012, Real-TimeMolecular Imaging throughout the Entire Cell Cycle by Targeted Plasmonic-Enhanced Rayleigh/Raman Spectroscopy. Nano Letters 12, 5369-5375.

b. Plasmonic Photo-Thermal Therapy (PPTT) of Cancer: Animal studies:
Owing to their characteristic Localized Surface Pllasmon Resonance (LSPR), gold nanoparticles (AuNPs) which results from the absorption of light with resonant frequency and induce the coherent motion of the its conduction band electrons. This produces large surface electromagnetc fields. These decay either by giving off strongly enhanced light scattering (used for imaging) or via nonradiative processes (heat) resulting from the collisions between the excited oscillating electrons and the ionic lattice of the gold or silver metals (electron-phonon relaxation processes). We measured this to occur in the one picosecond timescale. We measured the time the hot metallic particle transfer its thermal energy to the surrounding (i.e. to the cancer cell to which it is attached) to be in the few hundreds of picoseconds resulting in its melting and destruction(1). The ability of these particles to heat the surrounding medium upon excitation, along with the sensitivity of cancer cells to hyperthermia, is exploited in the cancer treatment by the method we called the plasmonic photothermal therapy (PPTT) therapy. Plasmonic AuNPs are ideal candidates as photothermal contrast agents. They can be specifically attached to cancer cells via molecular targeting or systemically delivered to tumor sites via the enhanced permeability and retention (EPR) effect. Upon accumulation of the AuNPs at the disease site of interest, they can be triggered via external radiation, causing temperature increases characteristic of hyperthermia, and subsequently inducing apoptosis. Not only can the AuNPs target the disease site of interest for targeted PPTT, but their LSPR is tuned such that the particles can be triggered by near-infrared (NIR) light (650–900 nm) that easily passes through physiological tissues with minimal interference with water or the hemoglobin.
Our group demonstrated successful destruction of human oral squamous carcinoma cells (HSC-3), by selectively labelling them with antiEGFR conjugated AuNPs and irradiating them with a continuous wave (cw) visible laser to induce cell death (2). We later demonstrated the use of AuNRs for the NIR-triggered PPTT of HSC-3 tumor cells. Initially, we used antibody-conjugated AuNRs for the selective labeling of cancer cells in vitro.(3) Upon attachment of these photothermal contrast agents to the cell membrane,

near IR light (NIR) laser exposure activated the AuNRs, such that they released enough heat to induce membrane destruction in the labeled cancer cells leaving the healthy cells unaffected. After receiving the National institute of health funding in the USA, our group with the group of Dr Shin of Emory cancer center used this same technique into the in vivo regime, utilizing PEG-AuNRs that were not specific for cellular labeling, but were biocompatible and able to accumulate in HSC-3 tumor tissue due to the EPR effect.(4) These photothermal contrast agents were systemically delivered to mice, allowed to accumulate in tumor tissue, and then selectively activated via NIR laser irradiation, resulting in dramatic reduction in tumor growth. Recently, we demonstrated the optimization of AuNR-mediated PPTT (in vitro) by altering the AuNR's optical properties through nanoparticle size manipulation.(5). At the same time, two groups of Scientists at NRC in Cairo Egypt are doing studies on Mice and Rats and now moving to do it on Dogs. El-Sayed go to Egypt four times a year to give seminars and to direct the research at NRC and getting the NRC group in continuous contact with medical doctors at the National Cancer Center in Cairo. The minister of Health in Cairo is kept informed with the results of these groups and is kept informed by Professor El-Sayed with the progress in this field..

References:

1. Link, S, and El-Sayed, MA. Optical properties and ultrafast dynamics of metallic nanocrystals. Annu Rev Phys Chem 2003; 54: 331-366.
2. El-Sayed, IH, Huang, X, and El-Sayed, MA. Selective laser photo-thermal therapy of epithelial carcinoma using anti-EGFR antibody conjugated gold nanoparticles. Cancer Lett 2006; 239: 129-135.
3. Huang, X, El-Sayed, IH, Qian, W, and El-Sayed, MA. Cancer cell imaging and photothermal therapy in the near-infrared region by using gold nanorods. J Am Chem Soc 2006; 128: 2115-2120 (this paper was the most cited paper in that year in the Journal of the American Chemical Society).
4. Dickerson, EB, Dreaden, EC, Huang, X, El-Sayed, IH, Chu, H, Pushpanketh, S, et al. Gold nanorod assisted near-infrared plasmonic photothermal therapy (PPTT) of squamous cell carcinoma in mice. Cancer Lett 2008; 269: 57-66.
5. Mackey, MA, Ali, MR, Austin, LA, Near, RD, and El-Sayed, MA. The most effective gold nanorod size for plasmonic photothermal therapy: theory and in vitro experiments. J Phys Chem B 2014; 118: 1319-1326.

c. Determination of Cancer Cell Death Mechanisms, drug efficacy and drug Delivery by the observed changes in time of single cell or of its molecular contents using plasmonic enhanced imaging:

The use of the plasmonic (strong scattering and photo-thermal) properties of gold and silver nanoparticles made Nanotechnology a naturally growing field due to its integration into many biomedical applications. Within nanotechnology, gold nanoparticles (AuNPs) are some of the most heavily utilized nanomaterials due to their unique optical, physical

and chemical properties.[1] In particular, their enhanced light scattering provides several advantages when used in biological imaging or as sensing agent. When compared to commonly used fluorophores, AuNPs' scattered light is 4-5 orders of magnitude brighter.

Our group has made use of the enhanced light scattering, to not only image cellular environments, but also to continually observe real-time intracellular molecular changes during various cellular processes. In 2010, AuNP scattering in conjunction with dark field imaging was used to determine particle localization at the nucleus and to monitor cellular response after a cytotoxic level of AuNPs were delivered.[2] This foundational work was expanded upon in 2012, as non-cytotoxic concentrations of nuclear-targeted AuNPs were used to probe the real-time molecular changes at the nucleus during cell cycle progression.[3] In particular, AuNP scattering was exploited to simultaneously acquire structural and molecular information from a single-cell through Rayleigh and Raman imaging, and revealed a strong correlation between DNA and protein Raman vibrations and cell cycle phase progression. Intracellular AuNP coupled Raman spectroscopy was also used to determine drug efficacy and drug delivery in cancer cells after treatment with chemotherapeutic agents.[4, 5] This work demonstrated the ability of AuNP light scattering to continually assess the efficiency of drug delivery and drug efficacy in real-time as well as reduced the time required to obtain cytotoxicity drug profiles.

Moreover, nuclear AuNP scattering and Raman spectroscopy were used to reveal real-time molecular changes in human cancer cells during apoptosis[6]. The ability to directly compare morphological changes (i.e. Rayleigh scattering images) with molecular changes (i.e. Raman spectroscopy analysis) of the DNA/protein composition around the cell nucleus revealed the occurrence and dynamics of three apoptotic molecular events: protein denaturation, proteolysis, and DNA fragmentation. A temporal profile of these molecular events was also created. Together, these results concluded apoptotic cell death mechanism and demonstrated the potential of AuNP scattering to advance molecular and cellular biology methods to accurately assess therapeutic imaging and response.

By loading large number of drug molecules on nanoparticle surfaces and deliver them to the sick cell it kills the cell instantaneously minimizing the possibility of drug resistance to accur. The only question raised when this does not happen is whether or not the drug was actually delivered by being released from the surface of the nanoparticle. Due to their unique optical and physical properties,[7] plasmonic nanoparticles, specifically of gold nanoparticles have been heavily utilized in biomedical applications. Recently, we have employed gold nanoparticles to not only deliver the chemotherapeutic drug doxorubicin, but to also monitor its delivery in real-time using a new technique termed plasmonically-tunable Raman/fluorescence imaging spectroscopy (P-TRFIS).[8] This technique exploits the ability of gold nanoparticles to selectively turn "ON" or "OFF" Raman and fluorescence signals based upon the drug molecules distance from the nanoparticle surface. Doxorubicin (DOX), a common chemotherapeutic drug, was covalently attached to the gold nanoparticle surface using a pH-sensitive hydrozone linkage that is susceptible to cleavage in acidic environments, such as present in the cell

lysosomes. When the DOX-gold nanoparticle conjugate is initially administered to cancer cells, the Raman signals of DOX are greatly enhanced, while its fluorescence is quenched due to its proximity to the plasmonic field of the nanoparticles. Once the drug-nanoparticle conjugated entered the lysosome, the DOX is released from the nanoparticle resulting in the restoration of its fluorescence intensity and the disappearance of its Raman spectra. as it moves away from the thenanoparticle plasmoic field. By simultaneously tracking the intensity of the fluorescence and Raman spectra of DOX functionalized gold nanoparticles, we were able to monitor the drug delivery in real-time on the single cell level !

References:

1. P. K. Jain, X. H. Huang, I. H. El-Sayed and M. A. El-Sayed. (2008) Noble Metals on the Nanoscale: Optical and Photothermal Properties and Some Applications in Imaging, Sensing, Biology, and Medicine. Accounts of Chemical Research 41, 1578-1586.

2. B. Kang, M. A. Mackey and M. A. El-Sayed. (2010) Nuclear Targeting of Gold Nanoparticles in Cancer Cells Induces DNA Damage, Causing Cytokinesis Arrest and Apoptosis. Journal of the American Chemical Society 132, 1517-1519.

3. B. Kang, L. A. Austin and M. A. El-Sayed. (2012) Real-Time Molecular Imaging throughout the Entire Cell Cycle by Targeted Plasmonic-Enhanced Rayleigh/Raman Spectroscopy. Nano Letters 12, 5369-5375.

4. L. A. Austin, B. Kang and M. A. El-Sayed. (2013) A New Nanotechnology Technique for Determining Drug Efficacy Using Targeted Plasmonically Enhanced Single Cell Imaging Spectroscopy. Journal of the American Chemical Society 135, 4688-4691.

5. B. Kang, M. M. Afifi, L. A. Austin and M. A. El-Sayed. (2013) Exploiting the Nanoparticle Plasmon Effect: Observing Drug Delivery Dynamics in Single Cells via Raman/Fluorescence Imaging Spectroscopy. ACS Nano 7, 7420-7427.

6. B. Kang, L. A. Austin and M. A. El-Sayed. (2014) Observing Real-Time Molecular Event Dynamics of Apoptosis in Living Cancer Cells using Nuclear-Targeted Plasmonically Enhanced Raman Nanoprobes. ACS Nano 8, 4883-4892.

7. Jain, P. K.; Huang, X. H.; El-Sayed, I. H.; El-Sayed, M. A. *Accounts of Chemical Research* **2008,** 41, (12), 1578-1586.
8. Kang, B.; Afifi, M. M.; Austin, L. A.; El-Sayed, M. A. *ACS Nano* **2013,** 7, (8), 7420-7427.

d. Summary of the Nano-medicine research at Georgia Tech :

Gold nanoparticles exhibit a combination of physical, chemical, optical, and electronic properties unique from other biomedical nanotechnologies and provide a highly multifunctional platform with which to image and diagnose diseases, to selectively deliver therapeutic agents, to sensitize cells and tissues to treatment regimens, to monitor and guide surgical procedures, and to preferentially administer electromagnetic radiation to disease sites[1, 2]. Because of their large size, circulating nanoparticles preferentially accumulate at tumor sites and in inflamed tissues due to the characteristically defective architecture of the vessels which supply oxygen and nutrients to these tissues. Once circulating nanoparticles extravasate through these large vascular pores and into the disease site, they remain lodged due characteristically diminished lymphatic drainage and their low diffusivity. Gold nanoparticles can be used to deliver drugs or imaging contrast agents that otherwise exhibit poor solubility or pharmacokinetic profiles, or to deliver agents which are intrinsically susceptible to enzymatic degradation and/or exhibit poor intracellular penetration such as small interfering RNA (siRNA). Nanogold can be routinely surface functionalized with active ligands at densities that are 100- and 1000-fold higher than that achievable with conventional liposomes or PLGA nanoparticles, respectively, allowing their binding affinity to be optimized for a particular disease, type, stage, or patient. Because of their comparability in size to the distances between cell-surface targets, gold nanostructures can simultaneously engage multiple, adjacent receptor sites, achieving increased selectivity in their uptake through this multivalent avidity. The novel optical and electronic properties of gold nanoparticles are also particularly attractive for use in multimodal drug delivery applications where these structures can afford enhanced drug pharmacokinetics/biodistribution and simultaneous hyperthermia and radiation therapy contrast, as well as photo-imaging contrast, spectro-chemical diagnostic contrast, and, when molecularly directed to specific sub-cellular sites, intrinsic pharmaco-dynamic properties.

. **Thus Biomedical Research in El-Sayed Lab is** aimed to leverage the unique structural, optical, and electronic properties of gold nanotechnologies to improve cancer diagnostics and therapy and to understand molecular cell biology. These strategies broadly emphasize the development of nanoscale tools for **(i)** molecularly-targeted cancer diagnostics, **(ii)** laser-photo-thermal tumor therapy, and **(iii)** understanding the fundamental interactions of nanoscale materials with biological systems.

Early studies in his laboratory asked whether the unique optical properties of gold nanoparticles could be used to more easily discriminate cells based on the presence or absence of cellular biomarkers. Using antibody-gold nanoparticle conjugates targeting the cell-surface receptor, EGFR, they found that malignant cells could be selectively labeled with gold nanoparticles in vitro, providing high optical scattering contrast for identification using a simple light microscope or optical spectrometer.[3] In later work they extended this approach to develop multivalent analogues of small molecule inhibitors that block cancer cell signaling.[4] They found multivalent display improved drug performance several fold per drug molecule and could be extended to a variety of other therapeutic cell signaling cascades.

Another aspect of his research asks whether targeted gold nanoparticle delivery can facilitate improved cancer diagnostics and therapeutics in vivo. By designing rod-shaped gold nanoparticles capable of absorbing tissue-penetrating light waves and converting them into heat, they were able to show, for the first time, that gold nanorods could serve as efficient and systemically administerable contrast agents for laser photothermal tumor therapy.[5] They observed 2-4 fold increased heating in nanoparticle-treated tumors, resulting in 50% complete remission in a mouse cohort receiving their optimized treatment protocol. Extending this approach, they have also studied how electromagnetic enhancement by gold nanoparticles can augment cell killing in photodynamic therapy, where photoexcitation of small molecule 'photosensitizers' leads to the formation of toxic oxygen species. By tailoring gold nanoparticle size/shape to facilitate resonant electronic interaction with the photosensitizer, they were able to improve cell killing by up to 200-fold while greatly decreasing dose-limiting toxic effects.

In parallel, their research also seeked to better understand the ways that nanoscale materials can interact with and manipulate biological systems. By molecularly targeting gold or silver nanoparticles to discrete sub-cellular locations, they found that they can not only selectively perturb various biological process,[6] but also monitor in real-time[7] their dynamics via using rationally-designed nanoparticles that enhance, for example, Raman scattering or fluorescence quenching[8].

To summarize, El-Sayed's group biomedical research interfaces biomolecular recognition with the unique optical and electromagnetic properties of nanoscale noble metals, in particular, gold due to its nontoxic properties. These investigations seek to improve cancer detection and drug potency, while also developing new methods for remediating solid tumors and manipulating biological systems via nanoscale technologies. In addition, El-Sayed is now supervising two groups, one in the states and supported byNIH and another one in Egypt supported by the people of Egypt. In this work, the positive results his group obtained in the in-vitro cell experiments are being extended to cancer-ridden animals e.g. mice, rats and now dogs.

REFERENCES

1. Giljohann, D.A. et al. Gold Nanoparticles for Biology and Medicine. *Angew. Chem. Int. Ed.* **49**, 3280-3294 (2010).
2. Dreaden, E.C., Alkilany, A.M., Huang, X., Murphy, C.J. & El-Sayed, M.A. The Golden Age: Gold Nanoparticles for Biomedicine. *Chem. Soc. Rev.* **41**, 2740-2779 (2012).
3. El-Sayed, I.H., Huang, X. & El-Sayed, M.A. Selective laser photo-thermal therapy of epithelial carcinoma using anti-EGFR antibody conjugated gold nanoparticles. *Cancer Lett.***239**,129-135 (2006).
4. Dreaden, E.C., Mwakwari, S.C., Sodji, Q.H., Oyelere, A.K. & El-Sayed, M.A. Tamoxifen-Poly (ethylene glycol)-Thiol Gold Nanoparticle Conjugates: Enhanced Potency and Selective Delivery for Breast Cancer Treatment. *Bioconjugate Chem.* **20**, 2247-2253 (2009).
5. Dickerson, E.B. et al. Gold nanorod assisted near-infrared plasmonic photothermal therapy (PPTT) of squamous cell carcinoma in mice. *Cancer Lett.* **269**, 57-66 (2008).
6. Kang, B., Mackey, M.A. & El-Sayed, M.A. Nuclear Targeting of Gold Nanoparticles

in Cancer Cells Induces DNA Damage, Causing Cytokinesis Arrest and Apoptosis. *J. Am. Chem. Soc.* **132**, 1517-1519 (2010).
7. Kang, B., Austin, L.A. & El-Sayed, M.A. Real-Time Molecular Imaging throughout the Entire Cell Cycle by Targeted Plasmonic-Enhanced Rayleigh/Raman Spectroscopy. *Nano Lett.***12**, 5369-5375 (2012).
8. B. Kang, M. M. Afifi, L. A. Austin, M. A. El-Sayed, "Exploiting the Nanoparticle *Plasmon Effect: Observing Drug Delivery Dynamics in Single Cells via Raman/Fluorescence Imaging Spectroscopy," ACS Nano, 7 (8), 7420-7427 (2013).*

Research Support

The research activity of El-Sayed's group has been supported in the past 50 years by ~18 M dollars, mostly from the Department of Energy, the National Science Foundation, Office of Naval Research, USA Air force and NIH. At GeorgiaTech, he has continuous funding from the Julius Brown chair. The research funding he had has contributed to the education of over 100 Ph.D. students, 12 M.Sc.students and over 45 postdoctoral fellows. His laboratory attracted over 30 visiting Professors and scholars supported by their own funding. By mid of 2014, Over 670 papers were published, mostly in primary journal that received over .

Since joining Georgia Tech in 1994, El-Sayed supervised the research of over 25 graduate students, ten undergraduate students (four RUE students) and over seventeen postdoctoral fellows. His laboratory has attracted National and international Professors to spend time and carry out research in his Laboratoy.

At Georgia Tech, he and his group published over 340 papers in twenty years, mostly in peer reviewed journals of high impact factors.In the last 5 years the number of citations/paper has exceeded the one hundred

Research Training (Research Collaborators)

Postdoctoral or Research Scientist Fellows

Dr. T. Pavlopoulos (1962-1964) (Navy Research Lab, San Diego)
Dr. K. Eisenthal (1964-1965) (Columbia University)
Dr. J. K. Roy (1963-1965)
Dr. N. K. Chaudhuri (1964-1967) (University of Calcutta)
Dr. M. Bhaumik (1966) (Northrop)
Dr. W. Moomaw (1965-1966)(Tufts University)
Dr. D. Tinti (1967-1970)(University of California, Davis)

Dr. Eva Migirdicyan (1968-1969) (University of Paris)
Dr. T. Kuan (1969-1971) (Northrop)
Dr. O. Kalman (1969-1970)
Dr. A. Shain (1970-1971) (DuPont)
Dr. P. Esherick (1973-1975) (Sandia)
Dr. P. Zinsli (1973-1975) (University of Bern)
Dr. S. Sheng (1974-1976)
Dr. P. Avouris (1975-1977) (IBM)
Dr. J. Berg (1976-1978) (TRW)
Dr. R. Moncorges (1977)
Dr. A. Burns (1978-1980) (Sandia)
Dr. Jai-Hyung Lee (1980-1982) (Seoul National University)
Dr. J. Simon (1983-1984) (University of California, San Diego)
Dr. P. Dupuis (1983-1985) (University of Montreal, Canada)
Dr. P. Evesque (1984-1985) (CNRS, Paris)
Dr. K. Ismail (1985-1986) (University of Qatar)
Dr. E. Chronister (1985-1987) (University of California, Irvine)
Dr. A. Eychmuller (1987-1988) (Hahn Meitner Institute)
Dr. D.-J. Jang (1987-1989) (Seoul National University)
Dr. R. van den Berg (1988-1990) (Shell, Amsterdam)
Dr. Kuang-Jung (Gloria) Hsu (1989) (National Taiwan University, Taiwan*Dr.*
Dr Stephen Luganov (1993-1997) (Moscow State University,now areseaech Scientist at Coening))

Dr. Kyo Yoo Jung (1994-95) (Han Yang University, South Korea)
Dr. Valey Kamalov (1995-1996)(Chemical Phys. Institute, Russian Academy of Science)
Dr. Bingsou Zou (1997-1999)
Dr. Clemens Burda (1997-1998) Now a professor at Case Western Reserve
Dr. Jianping Wang (1999-)
Dr. Markus Braun (2000-2001) (University of Stuttgart)
Dr. Stephan Link (2000-200,now a Professor at Rice U.)
Dr. Dr. Wei Qian (2002-Present) (Research Scientist II)
Dr. Kyeong-Seok Lee (2005-2006, now head of a division at KIST,South Korea)
Dr. Xiaohua Huang (2006-2009,now Professor at U of Memphis)
Dr. Sujatha Pushpanketh (2006-2007) (Research Scientist)
Dr. Nasrin Hooshmand (2007 and 2013-Presen, she is a Professor in Iran)
Dr. Mahmoud Mahmoud (2007-Present)
Dr. Svetlana Neretina (2007-2009, now Professor at Temple University)
Dr Li Song
Dr N.Allam (Professor at the American U Of Cairo)
Dr F Saira (now a Professor in Pakistan)
Dr H.Nishikion (Professor in Japan)
Dr Bin Kang (Professor at theTechnicat University in Nanjing, China)
Dr Paul ***Szymanski*** *(Assistant to the director, LDL)*
Dr X Kang
Dr Megan Mackey (now a Research Scientist at Merk & Co)
Dr Sajanlal
Dr Steve Hira

Visiting Professors and Scholars
Prof. John Olmsted, American University of Beirut (1970-1971)

Prof. Peter Wagner, Michigan State (1971-1972)
Prof. W. Moomaw, Williams College (1971-1972)
Professor W. R. Ware, University of Western Ontario (1974-1975)
Anne-Marie Merle, University of Bordeaux, (1977-1978)
Prof. J. Prochorow, Polish Academy of Sciences (September - April 1979)
Dr. B. Karvaly, Hungarian Academy of Sciences (March 1979 - August 1981)
Dr. Francisco Pessine, University of Campinas, Brazil January 15 - March 15, 1980
Professor Paras Prasad - Spring 1981
Dr. Baohua Guo, Lanzhou Institute of Chemical Physics, Visiting Scholar (1982-1984)
Dr. G. Comtet, CNRS Fellow (1983-1984)
Dr. H. Niederwald, Deutsch Forschungsgemeinshaft Fellow (1983-1984)
Prof. E. Awad, American University of Beirut (1985-1987)
Prof. H. Morita, Chiba University, Japan (1989-1990)
Prof. E. Awad, American University of Beirut (1988-1994)
Prof. F. W. Froben, Freie University of Berlin (1991)
Prof. Ch. Bräuchle, University of Munich (1992) and (1993)
Prof. Kyung-Hoon Jung, WonKwang University, Korea (1994-1995)
Dr. V. Kamalov, Chemical Physics Istitute, Russian Academy of Sciences (1995-1996)
Prof. A. Henglein, Hans Meitner Institute (Spring, 1995)
Prof. M. Abdel Kader, Cairo University (1998)
Dr. Akihiro Furube, Osaka University (Fall 1999)
Prof. Yusei Miyagi, University of the Ryukyus, Okinawa, Japan (2000)
Prof. Curtis Shannon, Auburn University (2001)
Dr. Marie-Paule Pileni, Paris, France (2003
Prof. Ramazan Öztürk" Turkey
Sir John Thomas, United Kingdom (2007)
Prof. Hassan Talaat, Cairo, Egypt (2007)
Professor Nasrin Hooshmand, Iran, (2013-2014)
Professor Xu, China.(2013-2014)
Professor Bin Kang.China, 2012-2013

Ph.D. Students	**Thesis Title**
1. A. Yencha	"Absorption and Ionization Studies in the Vacuum Ultraviolet," 1968
2. B. Ziegler	"Heavy-Atom, Vibronic and Host-Crystal Perturbations on the Phosphorescence of Molecular Crystals" 1968
3. D. Demeo	"Photoionization and Photodissociation Cross-Sections of Crystals," 1969
4. E. Yee	"Triplet Energy Annihilation and Multiplication in Molecular Crystals," 1969
5. L. Hall	"Spin-Lattice Relaxation and Zeeman Effects in the Triplet State of Pyrazine," 1971
6. D. Owens	"Effects of Magnetic Field, Microwaves, Tempperature Changes on Phosphorescence-in Mixed Molecular Crystals
7. R. Chen	"Microwave Double Resonance Spectroscopy of 1,2,4,5, Tetrachlorobenzene," 1972
8. A.Gwaiz	"PMDR Spectroscopy of Aromatic Hydrocarbons and

	their N-heterocyclics. 1972
9. C. Lin	"Low Temperature Triplet Energy Traps in Organic Solids Using Phosphorescence-Microwave Double Resonance Spectroscopy: Monomer and Excimer," 1974
10. J. Chodak	"The Use of Phhophorescence Microwave Double Resonance in the Study of Static and Dynamic Molecular Properties," 1974
11. A Wilkerson	"The Study of Inter- and Intromolecular Energy Transfer in Organic Molecular Crystals," 1974
12. M. Leung	"Spin-Selectivity of Triplet State Photochemical Reactions by the Techniques of Phosphorescence Microwave Double Resonance," 1974
13. E. Gossett, Jr.	"Polarized Microwave-Phosphorescence Double Resonance Spectroscopy," 1974
14. R. Leyerle	"Low-Field Zeeman Phosphorescence-Microwave Double-Resonance Spectroscopy and the Mechanism of Intersystem Crossing," 1974
15. M. Souto	"Properties of the Triplet States of Ketones and Cyclic Hydrocarbons by Phosphorescence-Microwave Double-Resonance Methods," 1974
16. T. Akasheh	"Perturbation Effects on Molecular and Resonance Pair Triplet Excited States," 1977
17. A. Campion	"Energy Transfer in Inorganic, Organic and Biological Materials: Time-Resolved Laser Spectroscopy Studies," 1977
18. A. Merle	"The Origin of the Multiple Sites in a Shpol'slii Matrix," 1978
19. W. Pitts	"Triplet-Spin Labels in Structural and Dynamic Studies of Mixed Aromatic Solids," 1978
20. J. Terner	"Timer Resolved Resonance Raman Spectroscopy of Bacteriorhodopsin" 1979
21. D. Parker	"Multiphoton Ionization in Polyatomic Molecules," 1979
22. W. Hopewell	"Energy Transfer in Ionic and Molecular Systems," 1980
23. C. L. Hsieh	"Resonance Raman Spectroscopy of Bacteriorhodopsin: Photoisomerization of Retinal in Picosecond and Nanosecond Time Scales and Hydration Effects of Purple Membrane on File," 1981

24. J. Lurie	"Multiphoton Ionization-Dissocieation of Nitrogen-Containing Compounds by Visible and Ultraviolet Lasers," 1981
25. J. Fukumoto	"Protein and Chromophore Spectroscopy and Dynamics During the Photochemical Cycle of Bacteriorhodopsin,1982.
26. R. Pandolfi	"Multiphoton Ionization Mass Spectrometry by Visible and Ultravioled Pulsed lasers," 1982
27. J. Morgan	"Dephasing and Energy Transfer in Disordered Solids," 1983
28. D. Gobeli	"Dynamics of Laser Multiphoton Ionization Dissociation of Two, Four-Hexadiyne," 1984
29. Jeng-jiun Yang	"Experimental and Theoretical Studies on the Mechanism of Laser Multiphoton Ionization-Fragmentation of Some Benzene Derivatives," 1984
30. R. St. Pierre	"Reactions of Niobium Metal Clusters Toward Benzene and Other Cyclic Hydrocarbons," 1987
31. Tsong-Lin Tai	"Linear Reflectron Time-of-Flight Mass Spectrometric Studies of Laser Ionic Multiphoton Dissociation Dynamics," 1987
32. Chasn-lon Yang	"Transport Processes in Disordered Systems: Energy Transfer, Electrodeposition and Simulation of Chemical Reactions on Surfaces," 1987
33. Tim Corcoran	"The Role of Metal Cations in the Function of Bacteriorhodopsin," 1987
34. Du-Jeon Jang	"Picosecond Spectroscopic Studies of Energy and Proton Transfers," 1987
35. Diane M. Szaflarski	"Photodissociation Dynamics of Gas Phase Polyatomic Molecules Studied Using Laser Multiphoton Ionization Mass Spectrometry," 1988
36. Li Song	"Size Dependence of the Reactivity of Gaseous Niobium and Vanadium Clusters," 1989
37. Hyun Jin Hwang	"Translational Spectroscopy Studies on the Photo Dissociation of Organic Iodides and the Unimolecular Dissociation of $Cs(CsI)_n^+$ Clusters," 1991
38. Laura Sweetman	"The Effects of Various Perturbations on the Function of Bacteriorhodopsin," 1992

39. Shuguang Wu "Bacteriorhodopsin; Some Studies on its Structure, Function and Potential Use as Biomaterial," 1992

40. Gloria Lin "Studies of Perturbed and Mutated Purple MembranesUsing Steady State and Time-Resolved Spectroscopies," 1992

41. John Freitas : "The Structure and Dissociation Dynamics of Some Organic Iodides by State Selective Photofragment Translational Spectroscopy," 1993.

42. Nancy Zhang "Studies of Cation Binding to Bacteriorhodopsin and the Effects of Certain Mutations on its Structure and Function" 1993.

43. Keith Fagerquist "The Effect of AgI Polar Molecules on the Dissociation Dynamics of Ag Clusters Cations and Gaseous Clusters" 1994.

44. Jennifer Griffiths "Determination of the Location and Binding Mechanism of Metal Cations in Bacteriorhodopsin" 1996

45. DiFei Yang "Spectroscopic and Analytical Studies of Wild Type and Structurally Perturbed Bacteriorhodopsin" 1996

46. Temer Ahmadi "Colloidal Metallic and Gaseous Ionic Nanoparticles: Structure, Dynamics, and Catalysis" 1996

47. Tina Masciangioli "Structural and Dynamic Studies of Bacteriorhodopsin and its Variants" 1999

48. Reginald Little "Synthesis and Characterization of II-VI Semiconductor Quantum Dots, Quantum Shells, and Quantum Wells" 1999

49 Jianping Wang "Time-Resolved Spectroscopic Studies of the Dynamic Processes in Bacteriorhodopsin" 1999

50. Travis Christopher Green "Photo-Induced Charge Carrier Dynamics and Self-Organization in Semiconductor and Metallic Nanocrystals: In Between the Bulk and Individual Molecules" 1999

51. Stephan Link "Spectral Properties and Relaxation Dynamics of Surface Plasmon Electronic Oscillations in Gold and Silver Nanodots and Nanorods" 2000

52. Victor Volkov "Bacteriorhodopsin Excited State Dynamics and Photochemistry" 2000

53. Janet Petroski "Platinum Metal Nanoparticles: Investigation of the Shape, Surface, Catalysis, and Assembly" 2001

54. Nikoobakht, B. *"Synthesis, characterization and self-assembly of gold nanorods and surface-enhanced Raman studies, Georgia Institute of Technology" 2003*

55. Colin Heyes *"Protein Stability in Bacteriorhodopsin" 2003*

56. Christy Landes *"The Molecular-Nanoparticle Semiconductor Transition" 2003*

57. David Hathcock *"Dynamic and Catalytic Properties of Some Metallic Nanocrystals" 2004*

58. Radha Narananyan *"Shape-Dependent Nanocatalysis and The Effect of Catalysis on The Shape and Size of Colloidal Metal Nanoparticles" 2005*

59. Laurie Sanii *"Bacteriorhodopsin: Structure/Function Relationship" 2005*

60. Xiaohua Huang *"Gold Nanoparticles Used in Cancer Cell Diagnostics, Selective Photothermal Therapy and Catalysis of NADH Oxidation Reaction" 2006*

61. Susan Eustis *"Gold and Silver Nanoparticles: Characterization of their Interesting Optical Properties and the Mechanism of their Photochemical Formation" 2006*

62. Alexander Schill *"Interesting Electronic and Dynamic Properties of Quantum Dot Quantum Wells & other Semiconductor Nanocrystal Heterostructures" 2006*

63. Qusai Darugar *"Surface Effects on the Ultrafast Electronic Relaxation of Some Semiconductor and Metallic Nanoparticles" 2006*

62. Alexander Schill *"Interesting Electronic and Dynamic Properties of Quantum Dot Quantum Wells & other Semiconductor Nanocrystal Heterostructures" 2006*

63. Qusai Darugar *"Surface Effects on the Ultrafast Electronic Relaxation of Some Semiconductor and Metallic Nanoparticles" 2006*

64. Wenyu Huang *"Fundamental studies of the interaction between femtosecond laser and patterned monolayer plasmonic nanostructures" 2007*

65. Prashant Jain *"Plasmons in assembled metal nanostructures: Radiative and non-radiative properties, near-field coupling and its universal scaling behavior" 2008*

66. Biesso, Arianna *"Plasmonic field effects on the spectroscopic and photobiological function of the photosynthetic system of bacteriorhodopsin" 2008*

67. Christopher Tabor *"Some optical and catalytic properties of metal nanoparticles" 2009*

68. Chun-Wan Yen	*"Plasmon photochemistry on the nanoscale" 2011*
69. Erik Dreaden	*"Chemistry, photophysics, and biomedical applications of gold nanotechnologies" 2012*
70. Steven Hayden	*"Novel applications of nanotechnology in medicine and green energy" 2012*
71. Rachel Near	*"Theoretical and experimental investigation of the plasmonic properties of noble metal nanoparticles" 2013*
72. Megan Mackey	*"Gold Nanoparticles in Chemical and Photothermal Applications of Cancer Therapy" 2013*
73. Lauren Austin	*"Exploring Some Aspects of Cancer Cell Biology with Plasmonic Nanoparticles" 2014*

M. Sc. Students

S. Wilt	"Vibration Spectra and Structure of 1,4,7-Nonatriene," June, 1964 (M.Sc.)
R. Lam	"Phosphorescence Microwave Double Resonance Studies of Triphenylamine Molecules," September, 1974 (M.Sc)
Y. Morita	"The Effect of Ultraviolet Radiation and Oxygen on the Light Adaptation Process of Bacteriorhodopsin," October, 1978 (M.Sc)
L. Hashimoto	"Investigation of the Origin of the Exciton CD Spectrum of Bacteriorhodopsin," January , 1983 (M.Sc)
J.Hanamoto	"Investigation of the Role of Tyrosine in the Proton Pump Cycle of Bacteriorhodopsin," Winter 1984 (M.Sc.)
E. Jackson	"The Determination of the Rotational and Vibrational Distributions of .OH Formed from the Dissociation of $(H_2O)_2$ through Laser Induced Fluorescence" June 1990, (M.Sc); September, 1990 (C.Phil.)

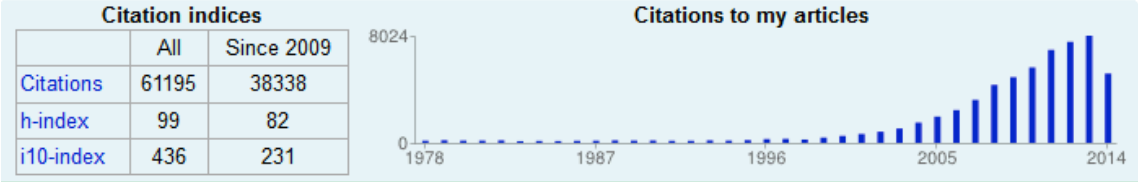
Adam Poncheri	*Plasmonic field effects of silver nanoparticle monolayers on poly(phenylene ethynylene) fluorescent polymers of different chain length" 2011*
Snyder, Brian	*"An investigation into bimetallic hollow nanoparticles in catalysis*"

Publications:

List of Published Research - M. A. El-Sayed

Publications from 1 to 332 are on research carried out at UCLA in the field of chemical Physics, spectroscopy and electronic energy relaxation in molecules and matter in different phases while publications from 333 present are on research carried out at LDL (Georgia Tech): http://ldl.gatech.edu started in 1994 and mostly in the field of Nanoscience and Nanotechnology. The relative citations to this work with time is given in the graph below and by titles and numbers, please go to: http://scholar.google.com/citations?user=BMpDLscAAAAJ&hl=en

List of Publications:



PART I
ELECTRONIC RELAXATION
UCLA
1962-1994

PART II
NANOSCIENCE & NANOTECHNOLOGY
GEORGIA TECH
1995-

PART I: Reseach on Molecular Spectroscopy& electronic Relaxation:
(Carried out at the University of California: 1962-1996)

1. M.A.El-Sayed and R. K. Sheline, "The Infrared Spectrum and Structure of Hexacyanodinickelate (I) Ion, [Ni2(CN)6]-4," J. Amer. Chem. Soc., 78 (1956).
2. M.A.El-Sayed and R. Wolfgang, "Chemical Reaction of Recoil Tritium with Gaseous Alkanes," J. Amer. Chem. Soc. 79, 3286 (1957).
3. M.A.El-Sayed, Peter Estrup, and R. Wolfgang, "Mechanism of the Reaction of Recoil Hydrogen in the Gaseous Phase," J. Phys. Chem., 62, 1356 (1958).
4. M.A.El-Sayed, " A Nuclear Method for Determining Very Low Vapor Pressures," Nucl. Instru., 3, 359 (1958).
5. M.A.El-Sayed and R. K. Sheline, "The Infrared Spectrum and Structure of the [Ni(CN) 4]-4 Ion," J. Amer. Chem. Soc., 80, 2047 (1958).
6. M.A.El-Sayed and R.K. Sheline, "The Position of the CN Stretching Frequency in Organic and Inorganic Molecules," J. Inorg. Nucl.Chem., 6, 187 (1958).

7. M.A.El-Sayed, "The Relation Between the CN Stretching Frequency and Hammett's s," J. Inorg. Nucl.Chem., 10, 168 (1959).
8. M.A.El-Sayed and M. Kasha, "Orbital Type Interchange by Solvation and Effects on the Emission Properties of Naphthalene N-heterocyclics," Spectrochimica Acta, 15, 758 (1960).
9. M.A.El-Sayed, M. Kasha, and Y. Tanaka, "Ionization Potentials of Benzene, Hexadeutero-benzene, and Pyridine from their Observed Rydberg Series in the 600-2000 Å," J. Chem. Phys., 34, 334 (1961).
10. M.A.El-Sayed and G. W. Robinson, "Excitation Transfer Splitting in the n ,π* Transitions of the Diazines," J. Chem. Phys., 34, 1840 (1961).
11. M.A.El-Sayed and G. W. Robinson, "Comments on a Communication by El-Sayed and Robinson," J. Chem. Phys., 35, 1896 (1961).
12. M.A.El-Sayed and G. W. Robinson, "Intramolecular Excitation Transfer.The Lowest n Æ p* Transitions in Pyrazine," Mol. Phys., 4, 273 (1961).
13. M.A.El-Sayed, "The Effect of Reducing the Symmetry on the Spectra of Benzene in the 1500-2000 Å Region: Spectra of Pyridine, Pyrimidine, and Pyrazine," J. Chem. Phys., 36, 552 (1962).
14. M.A.El-Sayed, "The Radiationless Processes Involving Change of Multiplicity in the Diazenes," J. Chem. Phys., 36, 573 (1962).
15. M.A.El-Sayed, "Perturbational Enhancement of the Coupling Between the Lowest Two Electronic p,p* States in Naphthalene," J. Chem. Phys., 36, 1943 (1962).
16. M.A.El-Sayed and H. D. Kaesz, "Assignment of the CO Stretching Absorptions in C4v Metal Pentacarbonyl Derivatives," J. Mol. Spect., 9, 310 (1962).
17. M.A.El-Sayed, M. T. Wauk, and G. W. Robinson, "Retardation of Singlet and Triplet Excitation Migration in Organic Crystals by Isotopic Dilution," Mol. Phys., 5, 205 (1962).
18. W.Rhodes and M. A. El-Sayed, "Observed Electronic Transitions in Hexahelicene," J. Mol. Spect., 9, 42 (1962).
19. M.A.El-Sayed, "Intramolecular Resonance Interaction Between Fundamental Vibrations of Polyatomic Molecules," J. Chem. Phys., 37, 680 (1962).
20. G.Dodson, M. A. El-Sayed, I. Stolz, and R. K. Sheline, "Photochemical Formation of Some Metal Hexacarbonylacetonitrile Derivatives," Inorg.Chem., 1, 526 (1962).
21. M.A.El-Sayed, "The Method of Oscillating Interacting Dipoles and the Vibrational Spectra of Some Organic and Metal Poly-Carbonyl Derivatives," Spectrochimica Acta, 18, 1387 (1962).
22. M.A.El-Sayed, "S-T Radiationless Process and the Emission Properties of Nitrogen Heterocyclics," Bull. Amer. Phys. Soc., 7, 499 (1962).
23. M.A.El-Sayed, "Proposed Effect of High Pressures on the Radiationless Processes," J. Chem. Phys., 37, 1568 (1962).
24. M.A.El-Sayed and H. D. Kaesz, "Infrared Spectra and Structure of the Tetracarbonyl Halide Dimers of Manganese, Technetium and Rhenium," Inorg.Chem., 2, 158 (1963).
25. M.A.El-Sayed, "Origin of the Phosphorescence Radiation in Aromatic Hydrocarbons," Nature, 197, 481 (1963).
26. M.A.El-Sayed, "Comments on Contaminating the Ground State with Triplet Character," J. Chem. Phys., 38, 3032 (1963).
27. M.A.El-Sayed, "Spin Orbit Coupling and the Radiationless Processes in Nitrogen Heterocyclics," J. Chem. Phys., 38, 2834 (1963).
28. M.A.El-Sayed, "Polarization of Molecular Luminescence in Plastic Media by the Method of Photoselection," J. Opt. Soc. Amer., 53, 797 (1963).

29. M.A.El-Sayed and T. Pavlopoulos, "Polarization of the Triplet-Triplet Absorption Spectrum of Some Polyacenes by the Method of Photoselection," J. Chem. Phys., 39, 834 (1963).
30. M.A.El-Sayed and R. G. Brewer, "Polarization of ð, ð* and n, ð* Phosphorescence Spectra of N-heterocyclics," J. Chem. Phys., 39 , 162 (1963).
31. M.A.El-Sayed and T. Pavlopoulos, "Intramolecular Heavy-Atom Effect on the Polarization of Naphthalene Phosphorescence," J. Chem. Phys., 39, 1899 (1963).
32. M.A.El-Sayed and M. Bhaumik, "Inter-Intra (Intera) Molecular Energy Transfer to Rare-Earth Ions in Chelates," J. Chem. Phys., 39, 2391 (1963).
33. M.A.El-Sayed, "A New Class of Photochromic Substances: Metal Carbonyls," J. Phys. Chem., 68, 433 (1964).
34. J.K.Roy and M. A. El-Sayed, "Donor-Acceptor Relative Orientation for Maximum Triplet-Triplet Energy Transfer," J. Chem. Phys., 40, 3442 (1964).
35. T.Pavlopoulos and M. A. El-Sayed, "Spectroscopic Investigation of the Mechanism of the Intramolecular Heavy Atom Effect on the Phosphorescence Process. I. Naphthalene Emission," J. Chem. Phys., 41, 1082 (1964).
36. M.A.El-Sayed, "Vanishing First- and Second-Order Intramolecular Heavy-Atom Effects on the (p* Æ n) Phosphorescence in Carbonyls," J. Chem. Phys., 41, 2462 (1964).
37. K.Eisenthal and M. A. El-Sayed, "Heavy-Atom Effects on Radiative and Radiationless Processes in Charge-Transfer Complexes," J. Chem. Phys., 42, 794 (1965).
38. M.L.Bhaumik and M. A. El-Sayed, "Mechanism and Rate of the Intramolecular Energy Transfer Process in Rare-Earth Chelates," J. Chem. Phys., 42, 787 (1965).
39. M.L.Bhaumik and M. A. El-Sayed, "Studies on the Triplet-Triplet Energy Transfer to Rare Earth Chelates," J. Phys. Chem., 69, 275 (1965).
40. M.L.Bhaumik and M. A. El-Sayed, "Mechanism of Energy Transfer in Some Rare- Earth Chelates," Applied Optics Suppl. 2 of Chem. Lasers, 214 (1965).
41. M.L.Bhaumik, L. Ferder, and M. A. El-Sayed, "Origin of the Molecular Phosphorescene in Some Europium Chelate Solutions," J. Chem. Phys., _42, 1843 (1965).
42. N.K.Chaudhuri and M. A. El-Sayed, "Concentration Depolarization of the Phosphorescence Emission," J. Chem. Phys., 42, 1947 (1965).
43. A.Udvarhazi and M. A. El-Sayed, "Vacuum-Ultraviolet Spectra of Cyclic Ketones," J. Chem. Phys., 42, 3335 (1965).
44. N.K.Chaudhuri and M. A. El-Sayed, "Host-Crystal Effects on the Mechanism of the Phosphorescence Process of Aromatic Hydrocarbons," J. Chem. Phys., 43, 1423 (1965).
45. N.K.Chaudhuri and M. A. El-Sayed, "Out-of-Plane Polarization in the Fluorescence Emission of Naphthalene-d8 in Durene," J. Chem. Phys. 43, 1424 (1965).
46. M.A.El-Sayed, "Theoretical Considerations Concerning the Intramolecular Heavy- Atom Effect on the Phosphorescence Process: C2V Symmetric Dihalonaphthalene," J. Chem. Phys., 43, 2864 (1965).
47. S.J.Wilt and M. A. El-Sayed, "The Vibrational Spectra and Structure of 1,4,7-Cyclononatriene and Related Derivatives," J. Amer. Chem. Soc., 88, 2911 (1966).
48. N.K.Chaudhuri and M. A. El-Sayed, "Host-Crystal Effects on the Mechanism of the p, p* Phosphorescence. II. N-Heterocyclic," J. Chem. Phys., 44, 3728 (1966).
49. M.A.El-Sayed and S. Siegel, "Method of Magnetophotoselection of the Lowest Excited Triplet State of Aromatic Molecules," J. Chem. Phys., 44, 1416 (1966).
50. S.K.Lower and M. A. El-Sayed, "The Triplet State and Molecular Electronic Processes in Organic Molecules," Chem. Reviews, 66, 199 (1966).
51. J.A.Duardo, F. M. Johnson, and M. A. El-Sayed, "A New Method for Observing the Inverse Raman (Absorption) Spectra," Phys. Letters, 21, 168 (1966).

52. M.A.El-Sayed, "Theoretical Considerations Concerning the Intramolecular Heavy- Atom Effect on the Phosphorescence Process," Proceedings of the International Conference on Luminescence, Budapest, August 1966; B.The Luminescence of Organic and Amorphous Materials. Publishing House of the Hungarian Academy of Sciences (1968), p. 373.
53. N.K.Chaudhuri and M. A. El-Sayed, "Induced Intramolecular Heavy-Atom Effects on the Phosphorescence Process by Host-Guest Crystal Interactions," J. Chem. Phys., 45, 1358 (1966).
54. W.Moomaw and M. A. El-Sayed, "Phosphorescence of Crystalline Pyrazine," J. Chem. Phys., 45, 3890 (1966).
55. M.A.El-Sayed, "Molecular Photochemistry," review of a book by N. Turro, American Scientist, 54, 375A (1966).
56. M.A.El-Sayed, F. M. Johnson, and J. Duardo, "A Comparative Study of the Coherent Raman Processes Using the Ruby and the Second Harmonic Neodymium Giant-Pulsed Lasers," Journal de Chimie Physique, 1, 227 (1967).
57. N.K.Chaudhuri and M. A. El-Sayed, "Molecular Origin of the Optical Rotatory Dispersion of the Benzil Crystal," J. Chem. Phys., 47, 1133 (1967).
58. W.Moomaw and M. A. El-Sayed, "Phonon-Induced Phosphorescence in Pyrazine Molecular Crystal," J. Chem. Phys., 47, 2193 (1967).
59. M.A.El-Sayed, "Medium Effects on the Phosphorescence Mechanism of Aromatic Hydrocarbons," J. Chem. Phys., 47, 2200 (1967).
60. N.K.Chaudhuri and M. A. El-Sayed, "Three-Dimensional Polarization Analysis of the Phosphorescence of Halonaphthalenes in Host Crystals," J. Chem. Phys., 47, 2566 (1967).
61. M.A.El-Sayed, "The Triplet State: Its Radiative and Nonradiative Properties, "Acc. Chem. Res., 1, 8 (1968).
62. L.Hall, A. Armstrong, W. Moomaw, and M. A. El-Sayed, "Spin-Lattice Relaxation and the Decay of Pyrazine Phosphorescence at Low Temperatures," J. Chem. Phys., 48, 1395 (1968).
63. M.A.El-Sayed and W. R. Moomaw, "Phosphorescence of Crystalline Pyrazine at 4.2 K," J. Chem. Phys., 48, 2502 (1968).
64. A.Yencha and M. A. El-Sayed, "Lowest Ionization Potentials of Some Nitrogen Heterocyclics," J. Chem. Phys., 48, 3469 (1968).
65. M.A.El-Sayed and W. R. Moomaw, "The Effect of Phonons on the Pyrazine Phosphorescence," in Excitons, Magnons and Phonons in Molecular Crystals, A.B. Zahlan, Editor; Cambridge University Press, 1968, p. 103.
66. M.A.El-Sayed, L. Hall, A. Armstrong, and W. R. Moomaw, "Spin Polarization and Spin-Lattice Relaxation in the Lowest Triplet State of Pyrazine at 1.6 K," in Excitons, Magonons and Phonons in Molecular Crystals, A. B. Zahlan, Editor; Cambridge University Press, 1968, p. 125.
67. M.A.El-Sayed, "Recent Studies on Triplet-Singlet Transitions in Aromatic Molecules," Acta Physica Polonica, 34, 649 (1968).
68. D.S.Tinti, W. R. Moomaw, and M. A. El-Sayed, "Fine Structure of the Pyrazine Crystal Phosphorescence at 4.2 K, " J. Chem. Phys., 50, 1035 (1969).
69. M.A.El-Sayed, W. R. Moomaw, and D. S. Tinti, "Time-Resolved Polarization Measurements of the Phosphorescence from the Different Zero-Field Multiplets of the Lowest Triplet State," J. Chem. Phys., 50, 1888 (1969).
70. M.A.El-Sayed, "The Intersystem Crossing to and the Phosphorescence from the Individual Sublevels of the Lowest Triplet State in Pyrazine at 1.6 K," in Proceedings, International Conference on Molecular Luminescence (Loyola University, Chicago, Illinois, 1968), E. Lim, Editor; W. Benjamin, Inc., New York, 1969, p. 715.

71. M.A.El-Sayed, D. S. Tinti, and D.V. Owens, "Spectroscopic Determination of the Most Probable Intersystem Crossing Route in Phosphorescing Molecules," Chem. Phys. Letters, 3, 339 (1969).
72. D.S.Tinti, M. A. El-Sayed, A. H. Maki, and C. B. Harris, "Phosphorescence- Microwave Double-Resonance (PMDR) Spectroscopy," Chem. Phys. Letters, 3, 343 (1969).
73. M.A.El-Sayed and L. Hall, "Determination of the Rate Constants of the Intersystem Crossing Processes to the Individual Zero-Field Levels of the Lowest Triplet State," J. Chem. Phys., 50, 3113 (1969).
74. M.A.El-Sayed, book review of The Triplet State, A. B. Zahlan, Editor; in Applied Optics, 8, 857 (1969).
75. C.B.Harris, D. S. Tinti, M. A. El-Sayed, and A. H. Maki, "Optical Detection of Phosphorescent Triplet State ENDOR in Zero Field," Chem. Phys. Letters, 4, 409 (1969)
76. M.A.El-Sayed, D. S. Tinti, and E. M. Yee, "Conservation of Spin Direction and Production of Spin Alignment in Triplet-Triplet Energy Transfer," J. Chem. Phys., 51, 5721 (1969).
77. M.A.El-Sayed, "Molecular Spectroscopy of the Triplet State," J. Amer. Chem. Soc., 91, 7210 (1969).
78. T.S.Kuan, D. S. Tinti, and M. A. El-Sayed, "Optical Detection of Electron-Electron Double Resonance (EEDOR) in Zero Field of the Triplet State," Chem. Phys. Letters, 4, 507 (1970).
79. D.A.Demeo and M. A. El-Sayed, "Ionization Potential and Structure of Olefins," J. Chem. Phys., 52, 2622 (1970).
80. D.S.Tinti and M. A. El-Sayed, "New Spectroscopic Techniques for Studying the Origin of Molecular Phosphorescence," presentation at the International Conference on Molecular Luminescence, Newark, Delaware, August, 1969, J. Luminescence, 1, 166 (1970).
81. Yee and M. A. El-Sayed, "Effects of Traps on Migration and Annihilation of Triplet Excitation in Phenanthrene Crystals," J. Chem. Phys., 52, 3075, (1970).
82. S.Ziegler and M. A. El-Sayed, "The Phosphorescence Mechanisms in Naphthalene N-Heterocyclics," J. Chem. Phys., 52, 3257 (1970).
83. D.V.Owens, M. A. El-Sayed, and S. M. Ziegler, "On the Anomalous Phosphorescence Polarization in Durene Host." J. Chem. Phys., 52, 4315 (1970).
84. M.A.El-Sayed and O. F. Kalman, "Polarization of the Magnetic Zero Field Transitions by Optical Detection," J. Chem. Phys., 52, 4903 (1970).
85. M.A.El-Sayed, "Proposed Method for Determining All the Rate Constants of Processes Involving the Lowest Triplet State at Low Temperature," J. Chem. Phys., 52, 6438 (1970).
86. M.A.El-Sayed, D. V. Owens, and D. S. Tinti, "Polarized Modulated PMDR Spectroscopy and the Zero-Field Origin in Phosphorescence," Chem. Phys. Letters, 6, 395 (1970).
87. M.A.El-Sayed, "Optical Pumping of the Lowest Triplet State and Multiple Resonance Optical Techniques in Zero Field," J. Chem. Phys., 54, 680 (1971).
88. M.A.El-Sayed, "Phosphorescence Microwave Multiple Resonance Studies in Determining the Radiative and Nonradiative Properties of the Triplet State," Accts. Chem. Res. 4, 23 (1971).
89. D.S.Tinti and M. A. El-Sayed, "Multiple Resonance Techniques and the Spectroscopy of the Triplet State," Organic Scintillators and Liquid Scintillation Counting, Academic Press, New York, (1971), p. 563.
90. D.S.Tinti and M. A. El-Sayed, "New Techniques in Triplet State Spectroscopy: Application to the Emission of 2,3-Dichloroquinoxaline," J. Chem. Phys. 54, 2529 (1971).
91.O.F.Kalman and M. A. El-Sayed," Optical Determination of the Polarization of Microwave Zero Field Transitions," J. Chem. Phys., 54, 4414 (1971).

92. L.H.Hall, D. V. Owens and M. A. El-Sayed, "Relaxation Mechanisms of the Zeeman Sublevels of the Phosphorescent Triplet State of Pyrazine at 1.6 K," Mol. Phys. 20, 1025 (1971).
93. L.H.Hall and M. A. El-Sayed, "Optical Determination of the Electron Spin-Lattice Relaxation Mechanisms Between the Zero Field Level of the Lowest Triplet State," J. Chem. Phys., 54, 4958 (1971).
94. M.A.El-Sayed, "Multiple Resonance Techniques in the Study of the Magnetic, Radiative and Nonradiative Properties of the Triplet State." Pure and Appl. Chem., 24, 475 (1971).
95. A.A.Gwaiz, M. A. El-Sayed and D. S. Tinti, "Assignment of the Lowest Triplet State of Benzene Using Phosphorescence-Microwave Double Resonance (PMDR) Techniques," Chem. Phys. Letters 9, 454 (1971).
96. C.R.Chen and M. A. El-Sayed, "The Relative Signs of the Zero-Field Parameters from Phosphorescence-Microwave Double Resonance (PMDR) Spectroscopy: 1,2,3,4-tetrachlorobenzene," Chem. Phys. Letters, 10 307 (1971).
97. M.A.El-Sayed and C. R. Chen, "The Intersystem Crossing in Symmetric Tetrachlorobenzene," Chem. Phys. Letters, 10 313 (1971).
98. John Olmsted, III and M. A. El-Sayed, "Phosphorescence Spectrum and Mechanisms of Benzaldenhyde in Methyl-Cyclohexane at 4.2 K," J. Mol. Spec., 40 71 (1971).
99. M.A.El-Sayed and John Olmsted, III, "Intersystem Crossing Relative Rates from Pulsed-Excitation Phosphorescence-Microwave Double Resonance," Chem. Phys. Letters, 11, 568 (1971).
100. Lawrence H. Hall and M. A. El-Sayed, "Magnetic Field Dependence of _&Spin- Lattice Relaxation Rates Between the Triplet State Zeeman Levels of Pyrazine-d 4 at 1.6 K," Mol. Phys., 22, 361 (1971).
101. M.A.El-Sayed, M. Leung and C. T. Lin, "PMDR Spectroscopy and the Geometry of the Triplet State," Chem. Phys. Letters, 14, 329 (1972).
102. M.A.El-Sayed, A. A. Gwaiz and C. T. Lin, "Triplet State Geometry of Hexachlorobenzene in Different Hosts at 1.6 K," Chem. Phys. Letters, 16, 281 (1972).
103. M.Leung and M. A. El-Sayed, "Hole Burning in the Optically Detected Zerofield Spectrum Using EEDOR, Chem. Phys. Letters, 16, 454 (1972).
104. M.A.El-Sayed, W. R. Moomaw and J. B. Chodak, "The Sensitivity of Pseudo-Jahn- Teller Distortion of Benzene to Host Crystal Structure," J. Chem. Phys., 57, 4061 (1972).
105. C.T.Lin, A. A. Gwaiz and M. A. El-Sayed, "Zero-Field Transitions of Triplet Excimers from Phosphorescence-Microwave Double Resonance Spectrosocopy," J. Amer. Chem. Soc., 94, 8234 (1972).
106. A.K.Wilkerson, C. T. Lin and M. A. El-Sayed, "Determination of Intermolecular Energy Transfer Routes by PMDR Spectroscopy," Chem. Phys. Letters, 17, 175 (1972).
107. M.A.El-Sayed, "Phosphorescence Microwave Multiple Resonance Spectroscopy," _MTP International Review of Science, Spectroscopy, Vol 3, A. D. Buckingham and D. A. Ramsay, editors, Butterworths, London (1972), p. 119
108. A.A.Gwaiz and M. A. El-Sayed, "The Molecular Geometry of Pyrazine in the Lowest Triplet State from PMDR Spectroscopy," Chem. Phys. Letters, 19, 11 (1973).
109. M.A.El-Sayed and C. T. Lin, "The Structure of Low Temperature Triplet Energy Traps in Molecular Crystals by PMDR Spectroscopy," Proceedings of the 6th Molecular Crystal Symposium, Schloss Elmau (1973).
110. M.A.El-Sayed, W. R. Moomaw and J. B. Chodak, "The Mechanism of the S1~~Tx Intersystem Crossing Process in Aromatic Hydrocarbons from PMDR," Chem. Phys. Letters, 20 11 (1973).

111. M.A.El-Sayed, "Triplet State Properties from Phosphorescence Microwave Double Resonance Studies," Proceedings of the International Conference on Luminescence, Leningrad, USSR, August, 1972, Luminescence of Crystals, Molecules and Solutions, Ferd Williams, editor, Plenum Press, New York (1973) pp. 45-55.
112. M.A.El-Sayed, "Investigating the Triplet State Properties by the Method of PMDR," Newletter (Izvestia) of the Soviet Academy of Sciences, Physical Series, Vol. 37 (1973) p. 248.
113. M.A.El-Sayed, E. Gossett and M. Leung, "Absolute Polarization and Microwave- Optical-Photoselection Spectroscopy (MOPS) of the Zero Field Transitions of the Triplet State," Chem. Phys. Letters, 21, 20 (1973).
114. M.A.El-Sayed, "Double Resonance Techniques and the Relaxation Mechanisms Involving the Lowest Triplet State of Aromatic Compounds,"Excited State, Vol 1, E. Lim, Editor, Academic Press, Inc., New York (1974). p. 35.
115. A.K.Wilkerson, J. B. Chodak and M. A. El-Sayed, "Phosphorescence Microwave Photoexcitation Spectroscopy: A New Technique for the Study of Energy Transfer in Molecular Crystals," Chem. Phys. Letters, 25, 464 (1974).
116. M.A.El-Sayed, C. T. Lin and R. Leyerle, "The Determination of the Structure of Low Temperature Triplet Energy Traps Using PMDR Methods. I.The Magnetic Axes of Hexachlorobenzene Excimers," Chem. Phys. Letters, 25, 457 (1974).
117. C.T.Lin and M. A. El-Sayed, "The Structure of Low Temperature Energy Traps in Organic Solids from PMDR Spectroscopy. II. 1,3,5-Trichloro and Hexa-chlorobenzenes," Chemical Physics 4, 161 (1974).
118. R.Leyerle and M. A. El-Sayed, "Low Field Zeeman Effect and the Mechanism of Intersystem Crossing Process," Proceedings of the Symposium on Molecular Structure and Spectroscopy, Columbus, Ohio, June, 1974, p. 124.
119. M.A.El-Sayed, "Effect of Spin Orbit Interactions on the Dipolar Nature of the Radiative Microwave Zero-Field Transitions in Aromatic Molecules," J. Chem. Phys. 60, 4502 (1974).
120.John Olmsted, III and M. A. El-Sayed, "Experimental Methods in Phosphorescence-Microwave Double Resonance,"Creation and Detection of the Excited State, Vol. 2, W. R. Ware, Editor, Marcel Dekker, Inc.New York (1974) pp. 1-62.
121. M.A.El-Sayed, "Phosphorescence-Microwave Multiple Resonance Spectroscopy," Advances in Photochemistry, Vol. 9, J. N. Pitts, Jr., George S. Hammond & Klaus Gollnick, editors,John Wiley & Sons, Inc., New York (1974) pp. 311-367.
122. E.W.Gossett and M. A. El-Sayed, "Optical Detection of Magnetic Circular Dichroism (ODMCD) for the Zero-Field Microwave Transitions of the Triplet State," J. Chem. Phys., 61, 3217 (1974).
123. C.T.Lin and M. A. El-Sayed, "Low Temperature Trapping Mechanisms in Molecular Solids Using PMDR Spectroscopy. III. Molecular Aggregation and the Formation of Hexachlorobenzene Triplet Eximer," Chemical Physics 5, 315 (1974).
124. Mark A. Souto, Peter J. Wagner and M. A. El-Sayed, "Magnetic and Optical Properties of the Triplet States of Para-Methoxy-and Para-Thiomethoxyacetophenone," Chemical Physics 6, 193 (1974).
125. R.W.Leyerle and M. A. El-Sayed, "Zeeman Effect and the Mechanism of the S1~~T1 Nonradiative Process," Conference on Radiationless Processes, Abstracts, Schliersee, West Germany, September 1974, p. 40.
126.Paul E. Zinsli and M. A. El-Sayed, "The Orientation of the Magnetic Axes of Quinoxaline and 2,3-Dichloroquinoxaline Triplets in a Durene Host Crystal from PMDR Methods," Chem. Phys. Letters, 30, 171 (1975).

127. M.Leung and M. A. El-Sayed, "Spin Selectivity in Low Temperature Solid State Photochemistry," J. Am. Chem. Soc. 97, 669 (1975).
128. M.A.El-Sayed and R. Leyerle, "Low Field Zeeman Effect and the Mechanism of the S 1 and T 1 Nonradiative Process, J. Chem. Phys. 62, 1579 (1975).
129. S.J.Sheng, M. A. El-Sayed and M. Leung, "Difference in Dipole Moment for Molecules in Different Zero-Field Levels of the Lowest Triplet State by Stark-PMDR Spectroscopy," J. Chem. Phys. 62, 1988 (1975).
130. E.W.Gossett and M. A. El-Sayed, "Polarization of Zero-Field Transitions of the Lowest Triplet State of Benzophenone," Chem. Phys. Letters, 32, 51 (1975).
131. Lawrence H. Hall and M. A. El-Sayed, "Temperature Dependence of the Spin- Lattice Relaxation Rates in the Triplet State of Pyrazine at Low Temperatures," Chem. Phys., 8, 272 (1975).
132. S.J.Sheng and M. A. El-Sayed, "Second Order Stark Effect on the Optically Detected Signals of the Zero-Field Transitions of the Triplet State," Chem. Phys. letters, 34, 216 (1975).
133.Paul E. Zinsli and M. A. El-Sayed, "The Mechanism of S1~~ T1 Nonradiative Process in Quinoxaline by Zeeman-PMDR Spectroscopy," Chem. Phys. Letters, 34, 403 (1975).
134.Peter Esherick, Paul Zinsli and M. A. El-Sayed, "The Low Energy Two Photon Spectrum of Pyrazine Using the Phoshorescence Photoexcitation Method," Chem. Phys., 10, 415 (1975).
135. M.A.El-Sayed, "Double Resonance and the Properties of the Lowest Excited Triplet State of Organic Molecules," Ann. Rev. of Phys. Chem., 26, 235 (1975).
136. Paul E. Zinsli and M. A. El-Sayed, "Zeeman Effect on the PMDR Signal and the Mechanism of the Intersystem Crossing Process in Pyrazine at 1.6 K," Chem. Phys. Letters, 36, 290 (1975).
137. M.A.El-Sayed and P. Zinsli, "Triplet Spin Label and Molecular Dynamics," J. of Luminescence 12/13, 389 (1976).
138. M.A.El-Sayed, "Photosphorescence-Microwave Double Resonance Spectroscopy," International Year Book, The Future of Science, Znanie Publishing House, Moscow, USSR (1976).
139. M.A.El-Sayed, "Molecular Fluorescence," Enciclopedia della Chimica Vol 5, USES (Utet-Sansoni edizioni scientifiche). Florence, Italy (1976).
140. M.A.El-Sayed, "Phosphorescence," Enciclopedia della Chimica Vol. 5, USES (Utet-Sansoni edizioni scientifiche), Florence Italy (1976).
141.Alan Campion and M. A. El-Sayed, "The Mechanism of the S1~~T1 Nonradiative Process in Duraldehyde," J. Phys. Chem., 80, 2201 (1976).
142. Talal Akasheh and M. A. El-Sayed, "Isotope Separation Using the Effect of Resonant Microwaves on the Rate of Triplet State Photochemistry in Solids," J. Phys. Chem. 80, 2710 (1976).
143.David H. Parker, S. J. Sheng and M. A. El-Sayed, "Multiphoton Ionization Spectrum of Trans-hexatriene in the 6.2 eV Region," J. Chem. Phys., 65, 5534 (1976).
144. S.J.Sheng and M. A. El-Sayed, "Electric Field Effect on the Spin Alignment of Triplet Traps of 4,4'-Dichlorobenzophenone Crystal," Chem. Phys. Letters, 45, 6 (1977).
145. Phaedon Avouris, William D. Hopewell and M. A. El-Sayed, "Energy Dependence of the Nonradiative Electronic Relaxation in Camphorquinone Vapor," J. Chem. Phys., 66, 1376 (1977).
146. Phaedon Avouris, Alan Campion and M. A. El-Sayed, "Luminescence and Intersystem Crossing Processes in Camphorquinone Crystals." Chem. Phys., 19, 147 (1977).

147.William M. Pitts and M. A. El-Sayed, "The Mechanism of the S1~~> T1 Electronic Energy Relaxation Process in Tetrachlorobenzene," Chem. Phys., 19, 289 (1977).
148. S.J.Sheng, M. A. El-Sayed and H. P. Trommsdorff, "Second Order Stark Shift of Zero-Field Transitions in Protonated and Deuterated p-Benzoquinones," Chem. Phys. Letters, 45, 404 (1977).
149. S.J.Sheng and M. A. El-Sayed, "Stark Effect on the Electron Spin Transition in Zero Magnetic Field for Polar Molecules," Chem. Phys., 20, 61 (1977).
150. Alan Campion, James Terner and M. A. El-Sayed, "Time-Resolved Resonance Raman Spectroscopy of Bacteriorhodopsin," Nature, 265, 659 (1977).
151. Phaedon Avouris, Alan Campion and M. A. El-Sayed, "Phonon Assisted Site-to-Site Electronic Energy Transfer Between Eu3+ Ions in an Amorphous Solid," Chem. Phys. Letters, 50, 9 (1977).
152. Phaedon Avouris, Alan Campion and M. A. El-Sayed, "Variations in Homogeneous Fluorescence Linewidth and Electron-Phonon Coupling Within an Inhomogeneous Spectral Profile," J. Chem. Phys., 67, 3397 (1977).
153.Alan Campion, M. A. El-Sayed and James Terner, "Resonance Raman Kinetic Spectroscopy of Bacteriorhodopsin on the Microsecond Time Scale," Biophys. J. 20, 369 (1977).
154.William M. Pitts and M. A. El-Sayed, "Cross Relaxation Between the Spin Levels of Phosphorescent 1,2,4,5-Tetrachlorobenzene and Photochemical Products of the Durene Hosts," Chem. Phys., 25, 315 (1977).
155. Phaedon Avouris, William M. Gelbart and M. A. El-Sayed, "Non-Radiative Electronic Relaxation Under Collision-Free Conditions," Chem. Rev., 77, 793 (1977).
156. James Terner, Alan Campion, and M. A. El-Sayed, "Time Resolved Resonance Raman Spectroscopy of Bacteriorhodopsin on the Millisecond Timescale," Proc. Natl. Acad. Sci. USA Vol. 74, No. 12, 5212 (1977).
157. Phaedon Avouris, Alan Campion and M. A. El-Sayed, "Laser Studies of Electron- Phonon Interactions and Amorphous Solids: Homogeneous Fluorescent Line- Broadening and Spectral Diffusion," Proc. Soc. Photo-Opt. Instru.Eng., 113, 57 (1977).
158. Alan Campion, M. A. El-Sayed and James Terner, "Time-Resolved Raman Spectroscopy: Application to the Photosynthetic Cycle of Bacteriorhodopsin," Proc. Soc. Photo-Opt. Instru. Eng. 113, 128 (1977).
159. A.M.Merle, W. M. Pitts and M. A. El-Sayed, "Distortion and Orientation for Triplet Coronene in Different n-Heptane Shpol'skii Sites Using Polarized Microwave MIDP Technique," Chem. Phys. Letters, 54, 211 (1978).
160. M.A.El-Sayed, A. Campion and P. Avouris, "Temperature, Temporal and .hlt super sub super sub Concentration Dependence of the Laser-Narrowed 5D0 ->7F0 Fluorescence Lineshape of Eu3+ in Glasses," J. of Mol. Structure 46, 355 (1978).
161. David H. Parker, Jacqueline O. Berg and M. A. El-Sayed, "The Symmetry of the 6.2 eV Two Photon Rydberg State in Hexatriene from the Polarization Properties of the Multiphoton Ionization Spectrum," Chem. Phys. Letters, 56, 197 (1978).
162. Jacqueline O. Berg, David H. Parker and M. A. El-Sayed, "Symmetry Assignment of Two-Photon States from Polarization Characteristics of Multiphoton Ionization Spectra," J. Chem. Phys., 68, 5661 (1978).
163.Jacqueline O. Berg, David H. Parker and M. A. El-Sayed, "Assignment of the Lowest Ionization Potentials in Pyridine and Pyrazine by Multiphoton Ionization Spectroscopy," Chem. Phys. Lett. 56, 411 (1978).
164. Alan W. Gertler, Jacqueline O. Berg and M. A. El-Sayed, "On the Mechanism of Photoinduced Nucleation in a Diffusion Cloud Chamber," Chem. Phys. Lett., 57, 343 (1978).

165. Anne-Marie Merle, Alan Campion and M. A. El-Sayed, "The Two-Photon Excitation Spectrum of Triphenylene in n-Heptane Single Crystals," Chem. Phys. Lett., 57, 496 (1978).
166. David H. Parker, Jacqueline O. Berg and Mostafa A. El-Sayed, "Multiphoton Ionization Spectroscopy of Polyatomic Molecules," Advances in Laser Chemistry, A. H. Zewail, ed., Springer Series in Chemical Physics (Springer, Berlin, Heidelberg, New York, 1978). P. 320.
167. James Terner and M. A. El-Sayed, "Time-Resolved Resonance Raman Characterization of the Intermediates of Bacteriorhodopsin," Biophys. J. 24, 262 (1978). 168. A.M.Merle, M. F. Nicol and M. A. El-Sayed, "Investigation of the Multiple Structure in Shpol'skii Spectra by calculation of the Aromatic-Alkane-Lattice Interaction," Chem. Phys. Lett., 59, 386 (1978).
169.William M. Pitts, Anne-Marie Merle and M. A. El-Sayed, "Spectroscopic Investigation of the Origin of Distortion of Guest Coronene in Various Sites of n-Heptane Shpol'skii Matrix," Chem. Phys., 36, 437 (1979).
170. Christina L. Gniazdowski, William M. Pitts and M. A. El-Sayed, "Magnetic Field Induced Cross Relaxation Between Two Different Spin Transitions of Triplet Coumarin," Chem. Phys., 39, 123 (1979).
171. James Terner, Chung-Lu Hsieh, and M. A. El-Sayed, "Time Resolved Resonance Raman Characterization of the bL550 Intermediate and the Two Dark-Adapted bR560 Forms of Bacteriorhodopsin," Biophys. J. 26, 527 (1979).
172. M.A.El-Sayed and James Terner, "Power - and Time - Resolved Resonance Raman Studies and Conformational Changes in Bacteriorhodopsin," Photochem. Photobiol. 30, 125 (1979).
173. M.A.El-Sayed, "Time Resolved Resonance Raman Spectroscopy in Photochemistry and Photobiology," in Multichannel Image Detectors in Chemistry, ACS SYMPOSIUM SERIES Bk. 102, Chpt. 10, pp. 215-227. (1979).
174. J.Terner, C-L. Hsieh, A. R. Burns and M. A. El-Sayed, "Time-Resolved Resonance Raman Spectroscopy of the Intermediates of Bacteriorhodopsin: The bK590 Intermediate," Proc. Natl. Acad. Sci. USA 76, 3046 (1979).
175. James Terner, Chung-Lu Hsieh, Alan R. Burns and M. A. El-Sayed, "Time-resolved Resonance Raman Characterization of the b0640 Intermediate of Bacteriorhodopsin. Reprotonation of the Schiff Base," Biochemistry 18, 3629 (1979).
176. Alan W. Gertler, Benilde Almeida, M. A. El-Sayed and Howard Reiss, "On the Radical Mechanism for Photoinduced Nucleation of Alkane Vapors," Chem. Phys. 42, 429 (1979).
177. David H. Parker and M. A. El-Sayed, "Determination of Excited State Lifetimes and Ionization Potentials by Dual Beam Visible Lasers," Chem. Phys. 42, 379 (1979).
178. J.Prochorow, W. Hopewell and M. A. El-Sayed, "The s-Substitution Effect, Intramolecular or Medium Induced?" Chem. Phys. Letters 65, 410 (1979).
179. D.H.Parker, R. Pandolfi, P. R. Stannard and M. A. El-Sayed, "Two-Photon MPI Spectroscopy of Alkyl Iodides," Chem. Phys. 45, 27 (1980).
180. Jonathan B. Lurie and M. A. El-Sayed, "Production and Bimolecular Quenching of Excited CN Radicals from Multiphoton Electronic Excitation of Benzoyl Cyanide," Chem. Phys. Letters 70, 251 (1980).
181. J.Terner, T. G. Spiro, M. Nagumo, M. F. Nicol and M. A. El-Sayed, "Resonance Raman Spectroscopy in the Picosecond Time Scale: The Carboxyhemoglobin Photointermediate," J. Am. Chem. Soc. 102, 3238 (1980).
182. William M. Pitts and M. A. El-Sayed, "Optical Detection of Spectral Diffusion of the Triplet State Zerofield Transition Energy," Mol. Cryst. Liq. Cryst. 25, 19 (1980)
183. Burns, M. a. El-Sayed and J. c. Brock, "Analysis of Spectral Diffusion of Localized Triplet Spin Transitions within an Inhomogeneous Profile," Chem. Phys. Letters 75, 31 (1980).

184. Jonathan B. Lurie and M. A. El-Sayed, "Chemiluminescence of CN Radicals Formed from Reaction of Nitric Oxide with Multiphoton Electronic Excitation Photofragments of Toluene," J. Phys. Chem. 84, 3348 (1980).
185. Joseph M. Fukumoto, William D. Hopewell, Bela Karvaly and M. A. El-Sayed, "Time-Resolved Protein Fluorescence Studies of Intermediates in the Photochemical Cycle of Bacteriorhodopsin," Proc. Natl. Acad. Sci. USA 78, No. 1, 252 (1981).
186. James Terner, John D. Stong, Thomas G. Spiro, Mark Nagumo, Malcolm Nicol and Mostafa A. El-Sayed, "Picosecond Resonance Raman Spectroscopic Evidence for Excited-state Spin Conversion in Carbonmonoxyhemoglobin Photolysis," Proc. Natl. Acad. Sci. USA 78, No. 3, 1313 (1981).
187. J.R.Morgan, E. P. Chock, W. D. Hopewell, M. A. El-Sayed and R. Orbach, "Origins of Homogeneous and Inhomogeneous Line Widths of the 5D0 - 7F0 Transition of Eu3+ in Amorphous Solids," J. Phys. Chem. 85, 747 (1981).
188. M.A.El-Sayed, "Time-Resolved Resonance Raman Techniques for Intermediates of Photolabile Systems," Springer Series in Optical Sciences, Vol. 26, Lasers and Applications, ed. by W.O.N. Guimaraes, C.-T. Lin and A. Mooradian (Springer-Verlag: Berlin, Heidelberg, New York, 1981) p. 295.
189. R.S.Pandolfi, D. A. Gobeli and M. A. El-Sayed, "Mechanism of Laser Multiphoton Ionization-Dissociation,A New Technique for Evaluating the Role of Neutrals," J. Phys. Chem. 85, 1779 (1981).
190. Mark Nagumo, Malcolm Nicol and Mostafa A. El-Sayed, "Polarized Resonance Raman Spectroscopy of the Photointermediate of Oxyhemoglobin on the Picosecond Time Scale," J. Phys. Chem. 85, 2435 (1981).
191. Chung-Lu Hsieh, Mark Nagumo, Malcolm Nicol and M. A. El-Sayed, "Picosecond and Nanosecond Resonance Raman Studies of Bacteriorhodopsin. Do Configurational changes of Retinal Occur in Picoseconds?" J. Phys. Chem. 85, 2714 (1981).
192. Jack R. Morgan and M. A. El-Sayed, "Temperature Dependence of the Homogeneous Linewidth of the 5D0 - 7F0 Transition of Eu3+ in Amorphous Hosts at High Temperatures," Chem. Phys. Lett. 84,213, (1981).
193. M.A.El-Sayed, Bela Karvaly and Joseph M. Fukumoto, "Primary step in the bacteriorhodopsin photocycle: Photochemistry or excitation transfer? Proc. Natl. Acad. Sci. 78(12), 7512 (1981).
194. Paras N. Prasad, Jack R. Morgan and Mostafa A. El-Sayed, "Spectral Diffusion in Orientationally Disordered Organic Solids," J. Phys. Chem. 85, 3569 (1981).
195. Jack R. Morgan and M. A. El-Sayed, "Temporal and Temperature Dependence of the Energy Transfer Process among Eu3+ in an Amorphous Solid," J. Phys. Chem. 85, 3566 (1981).
196. M.A.El-Sayed, "Time-Resolved Chromophore Resonance Raman and Protein Flourescence of Intermediates in Some Photobiological Changes," in TRENDS IN PHOTOBIOLOGY, Proc. 8th International Congress on Photobiology, ed. by C. Helene, M. Charlier, Th. Montenay-Garestier and G. Laustriat (Plenum: New York, London, Washington, D.C., Boston, 1982), pp 1-10.
197. Bela Karvaly, Joseph M. Fukumoto, William D. Hopewell and M. A. El-Sayed, "Polarized Photochemistry on Bacteriorhodopsin,Dichroism of the Early Photochemical Intermediate K610," J. Phys. Chem. 86, 1899 (1982).
198. M.A.El-Sayed, C. L. Hsieh and M. Nicol, "Resonance Raman Spectra of Picosecond Transients: Applications to Bacteriorhodopsin," in Picosecond Phenomena III, ed. by K. B. Eisenthal, R. M. Hochstrasser, W. Kaiser and A. Laubereau (Springer- Verlag, Berlin, 1982), pp 302-306.

199. M.A.El-Sayed, "Time-Resolved Chromophore Resonance Raman and Protein Flourescence of the Intermediates of the Proton Pump Photocycle of Bacteriorhodopsin," in METHODS IN ENZYMOLOGY, Vol 88, Biomembranes (Part I: Visual Pigments and Purple Membranes, II), ed. by Lester Packer (Academic Press, 1982), pp 617-625.
200. J.Terner, T. G. Spiro, J. D. Stong, M. Nagumo, M. Nicol and M. A. El-Sayed, "Picosecond Resonance Raman Spectroscopic Evidence for Excited State Spin Conversion in Carbonmonoxy-hemoglobin Photolysis," in Hemoglobin and Oxygen Binding, Chien Ho, ed. Elsevier-North Holland, NY (1982) pp. 355-361.
201. Jack R. Morgan and M. A. El-Sayed, "Energy Transfer Mechanism Switching in Disordered Solids," J. Phys. Chem. 87, 200 (1983).
202. Jack R. Morgan and M. A. El-Sayed, "Low-Temperature Energy Trapping and Emission Line Profile of Disordered Solids," J. Phys. Chem. 87, 383 (1983).
203. M.A.El-Sayed - BOOK REVIEW: Laser Spectroscopy of Solids.Vo.49.Topics in Applied Physics. Edited by W. M. Ten and P. M. Selzer.Springer-Verlag, Berlin, Heidelberg, New York. 1981.,310 pp. J. Am. Chem. Soc. 105, 3372 (1983).
204. Jack R. Morgan and M. A. El-Sayed, "Mechanism Switching and Trapping of Triplet-Triplet Energy Transfer in an Orientationally Disordered Molecular Solid," J. Phys. Chem. 87, 2178 (1983).
205. J.J.Yang, D. A. Gobeli, R. S. Pandolfi and M. A. El-Sayed, "Wavelength Dependence of the Multiphoton Ionization-Fragmentation Mass Spectrometric Pattern of Benzaldehyde," J. Phys. Chem. 87, 2255 (1983).
206. Chung-Lu Hsieh, M. A. El-Sayed, Malcolm Nicol, Mark Nagumo and Jai-Hyung Lee, "Time-Resolved Resonance Raman Spectroscopy of the Bacteriorhodopsin Photocycle on the Picosecond and Nanosecond Time Scales," Photochem. Photobiol.38,83(1983).
207. M.A.El-Sayed, Chung-Lu Hsieh and Malcolm Nicol, "Resonance Raman Spectra of Photochemical Picosecond Transients: Method and Application to Study Bacteriorhodopsin Primary Processes," in Time-Resolved Vibrational Spectroscopy, ed. by George H. Atkinson (Academic Press, New York, 1983) pp. 251-262.
208.Joseph M. Fukumoto and M. A. El-Sayed, "Adsorption Polarization Properties of Light-Adapted Bacteriorhodopsin in the 266-620nm Region," Photochem. Photobiol. 38, 79 (1983).
209. R.S.Pandolfi, D. A. Gobeli, Jonathan Lurie and M. A. El-Sayed, "Multiphoton Ionization Mass Spectrometric (MPIMS) Study of Phenol: Mechanism of Ionic Fragment Formation," Laser Chem. 3, 29 (1983).
210.Joseph M. Fukumoto, Jane H. Hanamoto and M. A. El-Sayed, "On the Tyrosinate Involvement in the Schiff Base Deprotonation in the Proton Pump Cycle of Bacteriorhodopsin," Photochem. Photobiol.39,75 (1984).
211. D.A.Gobeli, Jack R. Morgan, R. J. St. Pierre, and M. A. El-Sayed, "Studies of Rapid Dynamics in Laser-Multiphoton Ionization Dissociation Mass Spectrometry by Using Pump-Pump Two-Color Picosecond Lasers: 2,4-Hexadiyne," J. Phys. Chem. 88, 178 (1984).
212. D.A.Gobeli, J. D. Simon and M. A. El-Sayed, "Dynamics of Multiphoton Ionization-Dissociation of 2,4-Hexadiyne by the Two-Color Picosecond Pump-Pump Mass Spectrometric Technique: Formation of C6H5+, C4H4+, and C4H3+ Ions," J. Phys. Chem. 88, 3949 (1984).
213. M.A.El-Sayed, D. Gobeli and J. Simon, "Pump-Pump Picosecond Laser Techniques and the Energy Redistribution Dynamics in Mass Spectrometry," in Ultrafast Phenomena IV, Springer Series in Chemical Physics 39, eds. D. H. Auston and K. B. Eisenthal (Springer Verlag, Berlin Heidelberg New York, 1984) pp. 341-344.

214. Hansjorg S. Niederwald and M. A. El-Sayed, "Intermolecular Energy Transfer between the Individual Zero-Field Levels of Triplet Traps in an Orientationally Disordered Solid," J. Phys. Chem. 88, 5775 (1984).
215. D.A.Gobeli, J. J. Yang and M. A. El-Sayed, "Some Studies on Laser Multiphoton Ionization and Multiphoton Ionization Dissociation of Polyatomic Molecules," in Advances in Multi-Photon Processes and Spectroscopy, Vol. 1, ed. S. H. Lin (World Scientific, 1984) pp. 51-103.
216.Jane H. Hanamoto, Paul Dupuis and M. A. El-Sayed, "On the protein (tyrosine)-chromophore (protonated Schiff base) coupling in bacteriorhodopsin," Proc. Natl. Acad. Sci. USA 81, 7083 (1984).
217. J.J.Yang, J. D. Simon and M. A. El-Sayed, "Formation of C6H4Cl+ Ions by Laser Multiphoton Ionization-Fragmentation of 1,3-Dichloro benzene Using the Two-Color Picosecond Mass Spectrometric Technique," J. Phys. Chem. 88, 6091 (1984).
218. M.A.El-Sayed, "Techniques of time-resolved resonance Raman spectra of photochemical transients in the milli- to picosecond time scale," Pure & Appl. Chem. 57, 187 (1985).
219. D.A.Gobeli, J. D. Simon, D. K. Sensharma and M. A. El-Sayed, "Two Color Picosecond Lasers in Mass Spectrometry," Int. J. Mass. Spectrom. Ion Processes 63, 149 (1985).
220. D.A.Gobeli and M. A. El-Sayed, "Studies of rapid dynamics of 2,4 hexadiyne by the pump-pump picosecond laser mass spectrometric technique," Proc. SPIE-The International Society for Optical Engineer ing, Vol 533, pp. 72-77 (1985).
221. D.A.Gobeli and M. A. El-Sayed, "The Pump-Pump Picosecond Mass Spectrometric Technique and the Rate of Energy Distribution Prior to Ionic Fragmentation of 2,4-Hexadiyne by Laser Multiphoton Processes," J. Phys. Chem. 89, 1722 (1985).
222. J.J.Yang, M. A. El-Sayed and F. Rebentrost, "Multiphoton Ionization and Fragmentation of Benzaldehyde and Phenol: Statistical Products Phase Space Model Computations," Chem. Phys. 96, 1 (1985).
223. C.L.Yang, P. Evasque and M. A. El-Sayed, "'Fractal-like', but Non-Fractal, Behavior of One-Step Dipolar Energy Transfer on Regular Lattices with Excluded Volume," J. Phys. chem. 89, 346 (1985)
224. P.Dupuis and M. A. El-Sayed, "Effect of salt on the tyrosine and protonated Schiff base deprotonation kinetics in bacteriorhodopsin," Canadian Journal of Chemistry 63, 1699 (1985).
225. J.J.Yang, D. A. Gobeli and M. A. El-Sayed, "Change in the Mechanism of Laser Multiphoton Ionization-Dissociation in Benzaldehyde by Changing the Laser Pulse Width," J. Phys. Chem. 89, 3426 (1985).
226. J.D.Simon, Diane M. Szaflarski and M. A. El-Sayed, "A Computerized Two-Color Picosecond Laser Mass Spectrometer," Proc. Intl. Conf. on Lasers '84, November 26-30, 1984, pp. 176-181 (1985).
227. Paul Dupuis and M. A. El-Sayed, "Perturbation Effects on the Observed Deprotonation Processes in the Photocycle of Bacteriorhodopsin," Proc. Intl. Conf. on Lasers '84, November 26-30, 1984, pp. 408-415 (1985).
228. D.A.Gobeli, J. J. Yang and M. A. El-Sayed, "Laser Multiphoton Ionization- Dissociation Mass Spectrometry," Chem. Rev. 85, 529 (1985).
229. James Terner and M. A. El-Sayed, "Time-Resolved Resonance Raman Spectroscopy of Photobiological and Photochemical Transients," Acc. Chem. Res. 18,331(1985).
230. C.L.Yang, P. Evesque and M. A. El-Sayed, "Effect of Variation in the Microenvironment of the Fractal Structure on the Donor Decay Curve Resulting from a One-Step Dipolar Energy-Transfer Process," J. Phys. Chem. 90, 1284 (1986).

231. P.Evesque, C. L. Yang and M. A. El-Sayed, "Comparison between Electrodeposited Aggregates in Two Dimensions and the Fractal Pattern Calculated by the Witten-Sander Model," J. Phys. Chem. 90, 2519 (1986).
232. M.A.El-Sayed, Editor, "Laser Applications in Chemistry and Biophysics," Proc. SPIE 620, 136 pages (1986).
233. D.M.Szaflarski, J. D. Simon and M. A. El-Sayed, "The formation of C6H4Cl+ from 1,4-dichlorobenzene studied by picosecond multiphoton mass spectrometry," in Laser Applications in Chemistry and Biophysics, Mostafa A. El-Sayed, Editor, Proc. SPIE 620, pp. 57-62 (1986).
234.Timothy C. Corcoran, Paul Dupuis and M. A. El-Sayed,"The Effect of Ionic Strength and pH on the Protonated Schiff Base and Tyrosine Deprotonation Kinetics During the Bacteriorhodopsin Photocycle," Photochem.Photobiol.43, 655(1986).
235. Tsong-Lin Tai and M. A. El-Sayed, "Study of Kinetic Energy Release in Laser Multiphoton Ionization Fragmentation by Linear Reflectron," J. Phys. Chem. 90, 4477 (1986).
236.Diane M. Szaflarski, John D. Simon, and M. A. El-Sayed,"Study of the Low-Energy Channels in the Multiphoton Ionization Dissociation of 1,4-Dichlorobenzene by Two-Color Picosecond Laser Mass Spectrometry,"J. Phys. Chem. 90, 5050 (1986).
237. Paul Dupuis,Timothy C. Corcoran and M. A. El-Sayed,"Importance of bound divalent cations to the tyrosine deprotonation during the photocycle of bacteriorhodopsin," Proc. Natl. Acad. Sci. USA 82, 3662 (1985).
238. Tsong-Lin Tai and M. A. El-Sayed, "Determination of Unimolecular Ionic Formation Rates by Pulsed Laser-Linear Reflectron Time-of Flight Mass Spectrometry," Chem. Phys. Letters 130, 224 (1986).
239. C.L.Yang and M. A. El-Sayed, "Donor-Acceptor One-Step Energy Transfer via Exchange Coupling on a Fractal Lattice," J. Phys. Chem. 90, 5720 (1986).
240. D.A.Gobeli, J. S. Simon, Diane M. Szaflarski and M. A. El-Sayed, "Studies of Rapid Intramolecular and Intraionic Dynamic Processes with Two-Color Picosecond Lasers and Mass Spectrometry," in _Advances in Chemical Reaction Dynamics, P. M. Rentzepis and C. Capellos, eds. (D. Reidel Publishing Company, 1986), pp. 41-55.
241. Jack R. Morgan, Hansjorg S. Niederwald and M. A. El-Sayed, "Detection of Dipolar Contribution to the Mechanism of the Triplet-Triplet Energy Transfer Process in Molecular Solids," in Advances in Chemical Reaction Dynamics, P. M. Rentzepis and C. Capellos, eds. (D. Reidel Publishing Company, 1986), pp. 57-70.
242.Eric L. Chronister, Timothy C. Corcoran, Li Song and M. A. El-Sayed, "On the molecular mechanisms of the Schiff base deprotonation during the bacteriordhodopsin photocycle," Proc. Natl. Acad. Sci. USA 83, 8580 (1986).
243. Du-Jeon Jang, T. C. Corcoran, M. A. El-Sayed, L. Gomes, and F. Luty, "Determination of the Rapid Quenching Rates of Excited State F-Centers by OH- Defects in KC1," in Ultrafast Phenomena V, Springer Series in Chemical Physics 46, eds. G. R. Fleming and A. E. Siegman (Springer-Verlag, Berlin Heidelberg New York, 1986) pp. 280-283.
244. R.J.St. Pierre and M. A. El-Sayed, "Dependence of the Reaction Probability of Benzene on the Size of Gaseous Niobium Clusters," J. Phys. Chem. 91 763 (1987).
245. Eric L. Chronister and M. A. El-Sayed, "Time-Resolved Resonance Raman Spectra of the Photocycle Intermediates of Acid and Deionized Bacteriorhodopsin," Photochem. Photobiol. 45,507(1987).
246. M.A.El-Sayed, editor, “Laser Applications to Chemical Dynamics”Proceedings of SPIE-The International Society for Optical Engineering, SPIE vol 742, (1987)

247. R.J.St. Pierre, E. L. Chronister and M. A. El-Sayed, "Laser Studies of the Reactivity of Small Niobium Clusters with Benzene," in Laser Applications to Chemical Dynamics, Mostafa A. El-Sayed, Editor, Proc. SPIE Vol. 742, pp. 121-131 (1987)
248.Eric L.Chronister and M. A. El-Sayed, "Isomerization and Deprotonation During the Photocycle of Deionized and Acid Bacteriorhodopsin by Time Resolved Raman," in Time-Resolved Vibrational Spectroscopy, ed. George H. Atkinson (Gordon and Breach Science Publishers, New York, 1987) pp. 1-14.
249. Chan-Lon Yang, Zhong-Ying Chen and Mostafa A. El-Sayed, "Comparison of the Rates of Uni- and Bimolecular Diffusion-Controlled Reactions on Circular Filled Aggregates and Diffusion-Limited Fractal Aggregates in Two Dimensions," J. Phys. Chem. 91, 3002 (1987).
250. Diane M. Szaflarski, Eric L. Chronister and M. A. El-Sayed, "Laser Multiphoton Ionization Dissociation Mechanisms from Comparison of the Wavelength-Dependent Laser Mass Spectra with that Predicted from the Breakdown Curves: 2,4-Hexadiyne," J. Phys. Chem. 91, 3259 (1987).
251.Timothy C. Corcoran, Kamal Z. Ismail and Mostafa A. El-Sayed, "Evidence for the involvement of more than one metal cation in the Schiff base deprotonation process during the photocycle of bacteriorhodopsin,"Proc. Natl. Acad. Sci. USA 84, 4094 (1987).
252. J.R.Morgan, H. S. Niederwald, Chan-Lon Yang and M. A. El-Sayed, "Contribution of Dipolar Coupling to the Mechanism of the Triplet-Triplet Energy Transfer Process at Long Distances; A Double Resonance and Laser Line Narrowing Study," Acta Physica Polonironsted Acid Sites in a Calcinated Vycor Glass," J. Phys. Chem. 91, 4556 (1987).
253. R.J.StPierre, E.L. Chronister, and M.A.El-Sayed, "Reactivity of Gas-Phase Niobium Clusters toward Several Cyclic Hydrocarbons," J.Phys.Chem. 91, 4648 (1987)
254. Yang, M.A. El-Sayed, "Apparent Fractional Dimensionality of Uranyl-Exchanged Ziolites and their Photocatalytic Activity, J. Phys.Chem. 91, 4440 (1987)
255. C.T.Lin, W.L. Hsu, C.L. Yang, M.A. El-Sayed, "Emission Spectroscopic Evidence of Bronsted Acid Sites in a Calcinated Vycor Glass," J. Phys.Chem.91, 4556-4559 (1987).
256. R.J.St. Pierre, E. L. Chronister and M. A. El-Sayed, "Photochemical Dehydrogenation of Benzene Chemisorbed on Small Niobium Metal Clusters," J. Phys. Chem. 91, 5228 (1987).
257. T.C.Corcoran, E. S. Awad and M. A. El-Sayed, "The Role of Metal Ions in Bacteriorhodopsin Function," in Primary Processes in Photobiology, Proc. of the 12th Taniguchi Symposium, Japan, T. Kobayashi, Ed.; Springer-Verlag: Berlin Heidelberg New York, 1987; pp 223-232.
258. M.A.El-Sayed, "On the Electrostatic Model of the Deprotonation of the Schiff Base During the Photocycle of Bacteriorhodopsin," in Biophysical Studies of Retinal Proteins, Proc. of a Conference in Memory of Laura Eisenstein, T. G. Ebrey, H. Frauenfelder, B. Honig, and K. Nakanishi, editors; Univ. of Illinois Press, Urbana-Champaign, 1987; pp. 174-180.
259. Li Song, Alexander Eychmuller and M. A. El-Sayed, "Cluster Size of the Chemical Stereoselectivity in the Nbx + BrCN Reactin, J. Phys. Chem. 92, 1005 (1988).
260.Diane M. Szaflarski and M. A. El-Sayed,"Kinetic Energy and Formation Mechanisms of I+ and CH3+ from 266-nm Picosecond versus Nanosecond Laser Multiphoton Absorption" J. Phys. Chem. 92, 2334 (1988).
261. E.L.Chronister, D. M. Szaflarski, M. A. El-Sayed, J. Silberstein, I. Salman, and R. D. Levine, "Dependence of the Branching Ratio of on the Parent Ion Energy in 2,4- Hexadiyne Ionic Dissociation.Statistical Theory and Experiment," J. Phys. Chem. 92, 2824 (1988).
262. Du-Jeon Jang, Timothy C. Corcoran and M. A. El-Sayed, "Effects of Metal Cations, Retinal, and the Photocycle on the Tryptophan Emission in Bacteriorhodopsin," Photochem. Photobiol.48, 209 (1988).

263. Du-Jeon Jang and M. A. El-Sayed, "Deprotonation of lipid-depleted bacteriorhodopsin," Proc. Natl. Acad. Sci. USA 85, 5918 (1988).
264. Diane M. Szaflarski and M. A. El-Sayed, "Multiphoton Absorption Fragmentation Mechanisms of CH3I by Picosecond and Nanosecond Laser Mass Spectrometry," in Atomic and Molecular Processes with Short Intense Laser Pulses, Andre D. Bandrauk, ed., NATO ASI Series, Physics, Vol. B.; Plenum, New York, 1988; pp 371-375.
265. M.A.El-Sayed and Tsong-Lin Tai, "Kinetic Energy of Fragment Ions by Pulsed Laser-Pulsed Extraction Field Technique and the Mechanism of Laser Multiphoton Ionization Dissociation: 2,4-Hexadiyne," J. Phys. Chem. 92, 5333 (1988).
266. Li Song and M. A. El-Sayed, "Bromine Abstraction Versus Dehydrogenation in the Reaction of Gaseous Niobium Clusters with Saturated and Unsaturated Organic Bromides," Chem. Phys. Lett.152, 281 (1988).
267. M.A.El-Sayed, "On the Molecular Mechanisms of Solar Energy Storage During the Photocycle of the Other Photosynthetic System in Nature, Bacteriorhodopsin," Int. J. Quantum Chem. 22, 367-375 (1988).
268.Alexander Eychmuller, Li Song and Mostafa A. El-Sayed, "Size and Laser Ionization Wavelength Dependence of the Nbx + BrCN Gaseous Reaction," J. Phys. Chem. 93, 404 (1989).
269. Li Song, Alexander Eychmuller, R. J. St. Pierre, and M. A. El-Sayed, "Reaction of Carbon Dioxide with Gaseous Niobium and Niobium Oxide Clusters," J. Phys. Chem. 93, 2485 (1989).
270. Lin, Y. G. Chyan, G. C. Kresheck, Herbert C. Bitting Jr. and M. A. El-Sayed, "Interaction of Dibucaine.CHl Local Anesthetics with Bacteriorhodopsin in Purple Membrane: A Spectroscopic Study," Photochem. Photobiol.49, 641 (1989).
271. Chan-lon Yang, Pierre Evesque and Mostafa A. El-Sayed, "Effects of Finite Volumes on Electronic Energy Transfer," in Molecular Dynamics in Restricted Geometries, Klafter, J. and Drake, J.M. Eds; John Wiley & Son: New York, 1989, Chapter 13, pp. 371-386.
272. Du-Jeon Jang and M. A. El-Sayed, "Perturbation Effects on the Tryptophan Fluorescence in Bacteriorhodopsin," in Biomolecular Spectroscopy, Robert R. Birge and Henry H. Mantsch, Eds.; SPIE 1057, pp. 113-124 (1989).
273. Hyun Jin Hwang, Dilip K. Sensharma and Mostafa A. El-Sayed, "Unimolecular Decomposition of SputteredCs(CsI)n + Clusters: Stabilities and Evaporation Energetics," J. Phys. Chem. 93, 5012-5015 (1989).
274. M.A.El-Sayed, C. T. Lin and W. R. Mason, "Is there an excitonic interaction or antenna system in bacteriorhodopsin?" Proc. Natl. Acad. Sci. USA 86, pp. 5376-5379 (1989).
275. Du-Jeon Jang and M. A. El-Sayed, "Tryptophan fluorescence quenching as a monitor for the protein conformation changes occurring during the photocycle of bacteriorhodopsin under different perturbations," Proc. Natl. Acad. Sci. USA 86, pp. 5815-5819 (1989).
276. Hyun Jin Hwang, Dilip K. Sensharma and Mostafa A. El-Sayed, "Kinetic Energy Release Distribution and the Mechanism for Evaporation of One and Two CsI Molecules from Sputtered Cs(CsI)n+ Clusters," Chem. Phys. Lett.160, 243-249 (1989).
277.Diane M. Szaflarski, R. van den Berg, and M. A. El-Sayed, "Velocity Distributions of Iodide Cations as a Monitor of the Mechanism of Laser Multiphoton Dissociation Ionization of Iodo Compounds," J. Phys. Chem. 93, 6700 (1989).
278. Joel E. Morgan, Peter Mark Li, Du-Jeon Jang, M. A. El-Sayed, and Sunney I. Chan, "Electron Transfer between Cytochrome a and Copper A in Cytochrome c Oxidase: A Perturbed Equilibrium Study," Biochemistry 28, 6975 (1989).
279. Hyun Jin Hwang, Dilip K. Sensharma, and Mostafa A. El-Sayed, "Size and Temporal Dependence of the Average Kinetic-Energy Release during the Evaporation of Sputtered Cs(CsI)n+Clusters," Phys. Rev. Lett.64,808 (1990).

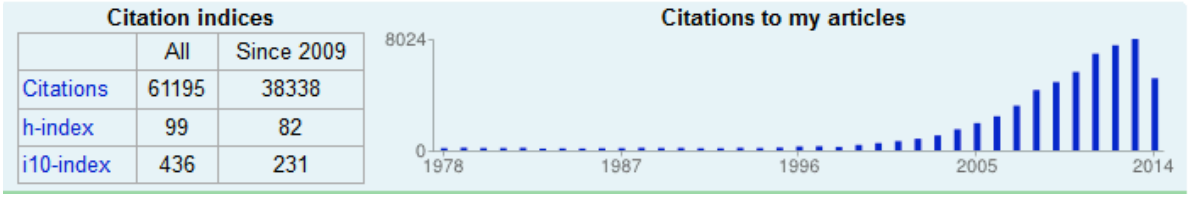
280. Li Song, John E. Freitas, and M. A. El-Sayed, "Mechanisms of the Reaction of Unsaturated Organic Halides with Small Gas-Phase Vanadium Clusters," J. Phys. Chem. 94, 1604 (1990).
281. Du-Jeon Jang, R. van den Berg and M. A. El-Sayed, "Absence of tryptophan fluorescence quenching by metal cations in delipidated bacteriorhodopsin," FEBS Lett.261,279 (1990).
282. R.van den Berg, Du-Jeon Jang, and M. A. El-Sayed, "Decay of the tryptophan fluorescence anisotropy in bacteriorhodopsin and its modified forms," Biophys. J. 57, 759 (1990).
283. Du-Jeon Jang, M. A. El-Sayed, Lawrence J. Stern, Tatsushi Mogi and H. Gobind Khorana, "Sensitivity of the retinal circular dichroism of bacteriorhodopsin to the mutagenetic single substitution of amino acids: tyrosine," FEBS Lett.262, 155 (1990).
284.Herbert C. Bitting, Jr., Du-Jeon Jang and M. A. El-Sayed, "On the Multiple Cycles of Bacteriorhodopsin at High pH," Photochem.Photobiol.51, 593 (1990).
285. R.van den Berg, Du-Jeon Jang, Herbert C. Bitting and M. A. El-Sayed, "Subpicosecond resonance Raman spectra of the early intermediates in the photocycle of bacteriorhodopsin," Biophys. J. 58, 135 (1990).
286. Du-Jeon Jang, M. A. El-Sayed, Lawrence J. Stern, Tatsushi Mogi and H. Gobind Khorana, "Effect of genetic modification of tyrosine-185 on the proton pump and the blue-to-purple transition in bacterio rhodopsin," Proc. Natl. Acad. Sci. USA 87, 4103 (1990).
287. Hyun Jin Hwang and Mostafa A. El-Sayed, "Determination of kinetic energy release for direct photodissociation process by one-dimensional TOF photofragment translational spectroscopy," Chem. Phys. Lett.170, 161 (1990).
288. Li Song and M. A. El-Sayed, "The Spatial Distribution and the Electronic State of Iodine Atoms Produced from the Reaction Products of Metal Clusters with Methyl Iodide," J. Phys. Chem. 94, 5650 (1990).
289. R.van den Berg and M. A. El-Sayed, "Subpicosecond resonance Raman spectroscopy of carbonmonoxy- and oxyhemoglobin," Biophys. J. 58, 931 (1990).
290. Li Song and M. A. El-Sayed, "Reaction of Niobium Clusters with Some Benzene Derivatives and Unsaturated Nonaromatic Hydrocarbons," J. Phys. Chem. 94, 7907 (1990).
291. R.van den Berg and M. A. El-Sayed, "Sub-picosecond Resonance Raman Spectroscopy of Some Biological Systems, in Ultrafast Phenomena VII, Springer Series in Chemical Physics Vol. 53, C. B. Harris, E. P. Ippen, G. A. Mourou, A. H. Zewail, Eds.; Springer-Verlag: Berlin, Heidelberg 1990; pp. 541-543.
292. G.C.Kresheck, C. T. Lin, L. N. Williamson, W. R. Mason, D.-J. Jang and M. A. El- Sayed, "The Thermal Stability of Native, Delipidated, Deionized and Regenerated Bacteriorhodopsin," J. Photochemistry and Photobiology 7, 289 (1990).
293. Shuguang Wu, Elias S. Awad and M. A. El-Sayed, "Circular dichroism and photocycle kinetics of partially detergent solubilized and partially retinal regenerated bacteriorhodopsin," Biophys. J. 59, 70 (1991).
294.Hiroshi Morita, John E. Freitas, and M. A. El-Sayed “Laser Ionic Multiphoton Dissociation of Some Acrylate Clusters,” J. Phys. Chem. 95, 1664, (1991).
295. Hyun Jin Hwang and Mostafa A. El-Sayed, “Polarization dependent translational energy release observed in the photodissociation of C2F5I at 304.7 nm,” J. Chem. Phys. 94 (7), 4877, (1991).
296. L.L.Sweetman and M.A. El-Sayed, “The Binding Site of the Strongly bound Eu3+ in Eu3+-regenerated bacteriorhosopsin, FEBS Lett.282, 436 (1991).
297. M.A.El-Sayed, “Size Dependence of Gaseous Cluster Reactivity and Evaporation Dynamics as a Mechanistic Probe, J. Phys. Chem. 95 3898-3906 (1991).(Feature Article)

298. Shuguang Wu and Mostafa A. El-Sayed, "CD spectrum of Bacteriorhodopsin; Best evidence against exciton model," Biophys. J., 60, 190 (1991).
299. Gloria C. Lin, Mostafa A. El-Sayed, Thomas Marti, Lawrence J. Stern, Tatushi Mogi and H. Gobind Khorana, "Effects of individual genetic substitutions of arginine residues ont he deprotonation and reprotonation kinetics of the Schiff base during the bacteriorhodopsin photocycle," Biophys. J., 60, 172 (1991).
300. Shuguang Wu, Du-Jeon Jang, M. A. El-Sayed, Thomas Marti, Tatsushi Mogi and H. Gobind Khorana, "The use of tryptophan mutants in identifying the 296 nm transient absorbing species during the photocycle of bacteriorhodopsin," FEBS Lett.284, 1, 9 (1991).
301. M.A.El-Sayed and G. Denardo, editors, "Lasers in Chemistry," Proceedings of the ICC International Conference, published by Indian Academy of Sciences, vol. 103, 1991.
302. M.A.El-Sayed, "Size dependence of gaseous cluster reactivity as a mechanistic probe," Proc. Ind. Acad. Sci. (Chem. Sci.), 103, No. 3, pp 277-282 (1991).
303. John E. Freitas, Hyun Jin Hwang, Amanda B. Tichnor and Mostafa A. El-Sayed, "The structure of the cyclohexyl radical from state-selective photofragment translational spectroscopy of the axial and equatorial conformers of iodocyclohexane," Chem. Phys. Lett., Vol. 183, No. 3,4, 165 (1991).
304. Hyun Jin Hwang and M. A. El-Sayed, "Symmetry and Product-State Correlation of the G State of I2 in the 304-nm Region," J. Phys. Chem., 95, 8044-8047 (1991).
305.Clifton K. Fagerquist, Dilip K. Sensharma and Mostafa A. El-Sayed, "Mixed" Metallic-Ionic Clusters of Silver/Silver Iodide," J. Phys. Chem., 95, 9169-9175 (1991).
306. Clifton K. Fagerquist, Dilip K. Sensharma and Mostafa A. El-Sayed, "Relative Stability, Possible Structural Formulas, and Unimolecular and Collision-Induced Dissociation of Negatively Charged Monoiodide Silver Clusters," J. Phys. Chem., 95, 9176-9180 (1991).
307. Gloria Lin, E. S. Awad, and M. A. El-Sayed, "Temperature and pH Dependence of the Deprotonation Step L550¨Æ M412 in the Bacteriorhodopsin Photocycle," J. Phys. Chem . 95, 10442-10447(1991).
308. Hyun Jin Hwang and M. A. El-Sayed, "Determination of the rapid energy redistribution rate in a transition state; Using the molecular rotation as a clock and translational energy release as an energy monitor: The photodissociation of iodobenzene," J. Chem. Phys., 96(1), 856-858, (1992).
309. N.Zhang, L. L. Sweetman, E. S. Awad, and M. A. El-Sayed, "Nature of the individual Ca2+ binding sites in Ca2+-regenerated bacteriorhodopsin," Biophys. J., 61, 1201-1206 , (1992).
310. Shuguang Wu, Yuejin Chang, M. A. El-Sayed, Thomas Marti, Tatsushu Mogi and H. Gobind Khorana, "Effects of tryptophan mutation on the deprotonation and reprotonation kinetics of the Schiff base during the photocycle of bacteriorhodopsin," Biophys. J., 61, 1281-1288, (1992).
311. M.A.El-Sayed, "On the Molecular Mechanisms of the Solar to Electric Energy Conversion by the Other Photosynthetic System in Nature, Bacteriorhodopsin," Acc.Chem Res., 25, 272-286,(1992).
312. Hyun Jin Hwang, J. Freitas, and M. A. El-Sayed, "Iodine Kinetic Energy: A Monitor for Dynamics of and Structure of Radicals Produced in the Photodissociation of Organic Iodides," in Time-Resolved Vibrational Spectroscopy V, H. Takahashi, ed., "Springer Proceedings in Physics, Vol. 68, 1992, pp 189-193.
313. C.T.Lin, C. J. Mertz, B. C. Bitting, and M. A. El-Sayed, "Fluorescence anisotropy studies of dibucaine·HCl in micelles and bacteriorhodopsin," J. Photochem. Photobiol. B: Biol., 13, 169-185, (1992).

314. Johnson, W. N. Shelton and M. A. El-Sayed, eds., Spectroscopy and Structure of Molecules and Nuclei, Proceedings of International Symposium, World Scientific, 1992, p. 297.
315. M.A.El-Sayed, "The Initial Steps in Solar Energy Storage by the Photosynthetic System of Bacteriorhodopsin," in Proceedings of International Symposium on Spectroscopy and Structure of Molecules and Nuclei, World Scientific, 1992, p. 297.
316. H.J.Hwang and M. A. El-Sayed, "Photodissociation of CF3I at 304 nm: Effects of Photon Energy and Curve Crossing on the Internal Excitation of CF3, J. Phys. Chem., 96, 8728-8735, (1992).
317. Abdel-Mottaleb and M. A. El-Sayed, guest editors, "Proc. Indian Acad. Sci (Chem. Sci.) 104(2) April (1992).
318. Shuguang Wu, Lisa M. Ellerby, J. S. Cohan, Bruce Dunn, M. A. El-Sayed, J. Selverstone Valentine, and Jeffrey I. Zink, "Bacteriorhodopsin Encapsulated in Transparent Sol-Gel Glass: A New Biomaterial," Chem. Mater., 5, 115-120 , (1993).
319. Y.N.Zhang, M.A. El-Sayed, M. L. Bonet, J. K. Lanyi, M. Chang, B. Ni, and R. Needleman, "Effects of genetic replacements of charged and H-bonding residues in the retinal pocket on CA2+ binding to deionized bacteriorhodopsin", PNAS, 90, 1445-1449, (1993).
320. M.A.El-Sayed, "Size Dependence of Metal Cluster Reactivity as a Probe of Chemical Reactions," in ON CLUSTERS AND CLUSTERING, From Atoms to Fractals, P.J. Reynolds, ed., Elsevier Science Publishers B.V. 69-76 (1993).
321. Clifton K. Fagerquist, Dilip K. Sensharma, Temer S. Ahmadi, and M. A. El-Sayed, "Adhesion of AgI Molecules to Gaseous Metallic Silver Cluster Cations," J.Phys.Chem, 97, 6598-6601 (1993).
322. Y. N. Zhang, M.A. El-Sayed, Lawrence J. Stern, Thomas Marti, Tatushi Mogi and H. Gobind Khorana, "Effects of Mutagenetic Substitution of Prolines on the Rate of Deprotonation and Reprotonation of the Schiff Base During the Photocycle of Bacteriorhodopsin," Photochem. Photobiol., 57, 6, 1027-1031, (1993).
323. L.Song, M. A. El-Sayed, and J. K. Lanyi, "Protein Catalysis of the Retinal Subpicosecond Photoisomerization in the Primary Process of Bacteriorhodopsin Photosynthesis," Science, 261, 891-894, (1993)
324. Shuguang Wu, Christoph Brauchle and Mostafa A. El-Sayed, "Recording of Transient Gratings Using the Short Lived Bacteriorhodopsin Photocycle Intermediates," Advanced Materials, 5, 11, 838-842 (1993).
325. John E. Freitas, Hyun Jin Hwang and Mostafa A. El-Sayed, "Molecular Rotation Clocking of the Subpicosecond Energy Redistribution in Molecules Falling Apart. 2.Excess Energy Dependence of the Rates of Energy Redistribution in the Two Photodissociation Channels of Iodobenzene," J.Phys.Chem, 97, 12481-12484, 1993. 326. Nancy Yi Zhang and M. A. El-Sayed, "The C-Terminus and the Ca2+ Low-Affinity Binding Sites in Bacteriorhodopsin," Biochemistry, 32, 14173-14175, 1993.
327. Abdel-Mottaleb and M. A. El-Sayed, guest editors, "Proc. Indian Acad. Sci", (Chem. Sci), 105 (6) December (1993)
328.Jennifer A. Griffiths and Mostafa A. El-Sayed, "The photodissociation of ICN at 304.67 nm by state-selective one-dimensional translational fragmentation spectroscopy," J. Chem. Phys. 100(7), 4910-4916, 1994.
329. Hyun Jin Hwang, Jennifer Griffiths and M. A. El-Sayed, "The one dimensional photofragment translational spectrscopic technique: intramolecular clocking of energy redistribution for molecules falling apart," Int J. Mass Spec. and Ion Proc., 131, 265-282, 1994.

330.John E. Freitas, Hyun Jin Hwang, and M. A. El-Sayed, “Excess Energy and Structural Dependence of the Rate of Energy Redistribution during the Photodissociation of Iodotoluenes,” J. Phys. Chem., 98, 3322-3329, 1994.
331. M.A.El-Sayed, “Solar-to-electric energy conversion by the other natural photosynthetic system,” in Science and Medicine in the 21st Century: A Global Perspective, The King Faisal Foundation, 171-184, 1994.
332. Shuguang Wu and M. A. El-Sayed, "Binding Characteristics of an Organometallic Cation, Ru(bpy)32+, in Regenerated bacteriorhodopsin," J.Phys.Chem., 98, 7246-7251, 1994.

PART II: Publications since moving to the Laser Dynamics Lab (LDL) at Georgia Tech in 1994: MOSTLY ON NANOSCIENCE and NANOTECHNOLOGY:



333. Li Song, Retinal photoisormerization process in bacteriorhodopsin: evidence for parallel photocycles," Biophys. J. 67(5), 2008-12, 1994
334. Shuguang Wu, M. A. El-Sayed, "Binding of, and Energy-Transfer Studies from Retinal to Organic Cations in Regenerated Reduced Bacteriorhodopsin," J. Phys. Chem., 98 (37;), 9339-44, 1994
335. Stephan L. Logunov, Li Song, Mostafa A. El-Sayed, "pH Dependence of the Rate and Quantum Yield of the Retinal Photoisormerization in Bacteriorhodopsin," J. Phys. Chem., 98 (42), 10674-7, 1994
336. Shuguang Wu, Christopher Braeuchle, Mostafa El-Sayed, "Recording of transient grating using the short lived bacteriorhodopsin photocycle intermediates." Adv. Mater, 5 (11), 838-42, 1994
337. Temer S. Ahmadi, M.A. El-Sayed, "Dynamics of Formation and Evaporation of Mixed Alkali Halide Nanocrystals; A Case of Comparable Lattice Energies", JPhysChem., 98 (44), 11316-20, 1994
338. John E. Freitas, M. A. El-Sayed, , and Hyun Jin Hwang, “The Wavelength Dependence of the Rates of Internal Energy Redistribution during the Photodissociation of 3-Iodopyridine”, J Phys Chem., 99 (19)7395-7406, 1995
339. M.A.El-Sayed, Jennifer Griffiths, Li Song and Nancy Zhang, "On the molecular mechanisms of the rapid and slow solar-to-electric energy storage processes by the other natural photosynthetic system, bacteriorhodopsin," Pure & Appl. Chem, 67, No. 1, 149-155, 1995
340. Difei Yang, Dan J. Castro, Ivan H. El-Sayed, Mostafa A. El-Sayed, Romaine E. Saxton, and Nancy Yi Zhang, “A Fourier-Transform Infrared Spectroscopic Comparison of Cultured Human Fibroblast and Fibrosarcoma Cells: A New Method for Detection of Malignancies”, J Clin. Laser Med. & Surg., 13 (2) 55-59, 1995

341. M.A.El-Sayed, I. Tanaka, and Y. Molin, editors, "Ultrafast Processes in Chemistry and Photobiology", IUPAC Series on Chemistry for the 21st Century, Blackwell Science, 1995.
342. Clifton K. Fagerquist, Dilip K. Sensharma, Mostafa A. El-Sayed, Angel Rubio, and Marvin L. Cohen, "enhancement of Metallic Silver Monomer Evaporation by the Adhesion of Polar Molecules to Silver Nanocluster Ions", J. Phys. Chem., 99, (19) 7723- 7730, 1995.
343. S.Masuda, M. Nara, M. Tasumi, M. A. El-Sayed, and J. K. Lanyi, "FTIR Spectroscopic Study of the Effect of Ca2+ Binding on the States of Aspartic Acid Side Chains in Bacteriorhodopsin," J.Phys.Chem., 99(19) 7776, 1995.
344. L.Song, D. Yang, M.A. El-Sayed and J.K.Lanyi, "Retinal Isomer Composition in Some Bacteriorhodopsin Mutants under Light and Dark Adaptation Conditions," J. Phys.Chem.99 (24) 10052-10055 (1995).
345. S.K.Yoo, E. S. Awad, and M. A. El-Sayed, "Comparison between the Ca2+ and Mg2+ binding to the high affinity sites in bacteriorhodopsin," J.Phys.Chem, 99, (29) 11600-11604 (1995).
346. D.Yang, D. J.Castro,I. H.El-Sayed, M.A.El-Sayed, R.E.Saxton and N.Y.Zhang, "A Fourier-Transform infrared spectroscopic comparison of cultered human fibroblast and fibrosarcoma Cells,"SPIE, V. 2389, p.542 (1995).
347. Kwang-Woo Jung, Jennifer A. Griffiths, and Mostafa A. El-Sayed, "Photofragment Translational spectroscopy of Ibr at 304 nm: Polarization dependence and dissociation dynamics", J. Chem Phys, 103, (16) 6999-7005 (1995)
348. D. Yang and M. A. El-Sayed, "The Ca2+ Binding to Deionized Monomerized and to Retinal Removed Bacteriorhodopsin", Biophys.J., 69, 2056-2059 (1995)
349. Mostafa A. El-Sayed, Difei Yang, Seoung-Kyo Yoo, and Nancy Zhang, "The Effect of Different Metal Cation Binding on the Proton Pumping in Bacteriorhodopsin", Israel Jour. Of Chem, 35, 1995, 465-474
350. Stephan L. Logunov, Mostafa A. El-Sayed, Li Song, and Janos K. Lanyi, "Photoisomerization Quantum Yield and Apparent Energy Content of the K Intermediate in the Photocycles of Bacteriorhodopsin, Its Mutants D85N, R82Q, and D212N, and Deionized Blue Bacteriorhodopsin", J.Phys.Chem, 100, (6) 2391-2398 (1996).
351.Jennifer A. Griffiths, John King, Defei Yang, Richard Browner, and M. A. El-Sayed, "Calcium and Magnesium Binding in Native and Structurally Perturbed Purple Membrane", J.Phys.Chem. 100(3) 929-933 (1996)
352. Valey F. Kamalov, Tina M. Masciangioli, and M. A. El-Sayed "Homogeneous Line Width of the Different Vibronic Bands of Retinal Absorption in Bacteriorhodopsin by the Hole-Burning Technique", J.Phys.Chem. 100(8) 2762-2765 (1996)
353. Jennifer A. Griffiths, Kwang-Woo Jung, and M. A. El-Sayed, "Fluorine Substitution Effects on the Photodissociation Dynamics of Iodobenzene at 304 nm", J. Phys. Chem. 100 (19) 7989-7996 (1996)
354. Valey F. Kamalov, Reginald Little, Stephan L. Logunov, and M. A. El-Sayed, "Picosecond Electronic Relaxation in CdS/HgS/CdS Quantum Dot Quantum Well Semiconductor Nanoparticles", J.Phys.Chem. 100, (16), 6381-6384 (1996)
355. Jennifer A. Griffiths, Tina M. Masciangioli, Cecile Roselli, and M. A. El-Sayed, "Monodentate vs Bidentate Binding of Lanthanide Cations to PO2 - in Bacteriorhodopsin", J. Phys. Chem. 100, (16) 6863-6866 (1996).
356. Temer S. Ahmadi, Stephan L. Logunov, Mostafa A. El-Sayed, "Picosecond Dynamics of Colloidal Gold Nanoparticles", J.Phys. Chem. , 100, (20) 8053-8056 (1996)
357. Stephan L. Logunov, Mostafa A. El-Sayed, Janos K. Lanyi, "Replacement Effects of neutral Amino Acid Residues of Different Molecular Volumes in the Retinal Binding

Cavity on Bacteriorhodopsin on the Dynamics of its Primary Process", Biophys.Journal, 70, 2875-2881(1996)
358. Li Song and M. A. El-Sayed, "The Effect of Changing the Position and Orientation of Asp85 Relative to the Protonated Schiff Base within the Retinal Cavity on the Rate of Photoisomerization in Bacteriorhodopsin", J.Phys.Chem, 100 (24) 1996, 10479-10481
359. T. S. Ahmadi, Z. L. Wang, A. Henglein, and M.A.El-Sayed, " 'Cubic' Colloidal Platinum Nanoparticles", Chem.Mater,8 (6) 1996, 1161-1163.
360. T. S. Ahmadi, Z. L. Wang, T. C. Green, A. Henglein, M. A. El-Sayed, "Shape Controlled Synthesis of Colloidal Platinum Nanoparticles" , Science, 272, 1924-1926 (1996)
361. J. A. Griffiths, M. A. El-Sayed, "Effect of Binding of Lanthanide Ions on the Bacteriorhodopsin Hexagonal Structure: An X-ray Study", J.Phys.Chem., 100 (29) 12002-12007 (1996)
362. L. Logunov, M. A. El-Sayed, J. K. Lanyi, "Catalysis of the retinal Subpicsecond Photoisomerization Process in Acid Purple Bacteriorhodopsin and Some Bacteriorhodopsin Mutants by Chloride Ions", BiophysicalJournal, 71, 1545-1553, (1996)
363. L.Cai, A. Rohatgi, D. Yang, M. A. El-Sayed, "Effects of rapid thermal anneal on refractive index and hydrogen content of plasma-enhanced chemical vapor deposited silicon nitride films",J.Appl.Phys, 80, (9), 5384-5388 (1996)
364. Stephan L. Logunov, Li Song, and Mostafa A. El-Sayed, "Excited State Dynamics of a Protonated Retinal Schiff Base in Solution", JPhysChem, 100(47), 18586-18591 (1996)
365. Cecile Roselli, Alain Bousac, Tony A. Mittioli, Jennifer a. Griffiths, and Mostafa A. El-Sayed, "Detection of a Yb3+ binding site in regenerated bacteriorhodopsin that is coordinated with the protein and phospholipid head groups", Proc.Natl.Acad.Sci. USA, 93, 14333-14337 (1996)
366. Hyun Jin Hwang, Mostafa A. El-Sayed, "Photodissociation dynamics of iodobenzene by state-selective photofragment translational spectroscopy", JPhotochem & Photobio A, 102, 13-20 (1996)
367. Temer S. Ahmadi and Mostafa A. El-Sayed, "Effect of Lattice Energy Mismatch on the Relative Mass Peak Intensities of Mixed Alkali Halide Nanocrystals", JPhysChemA, 101(4) 690-693 (1997)
368. S. Logunov and M. A. El-Sayed, "On the molecular origin of the protein catalysis of the primary process in bacteriorhodopsin photosynthesis: Retinal photoisomerization", Pure & Appl. Chem, 69, (4) 749-754, 1997.
369. H. Morita,J. Freitas, M. El-Sayed, "Laser Multiphoton Dissociation Ionization of Acrolein Clusters", JPhysChemA, 101(20) 3699-3701, 1997.
370. Li Song, M. A. El-Sayed, and Peter C. Chen, "Spectral diffusion within the porous silicon emission wavelength range on the nanosecond to millesecond time scale", J.Appl.Phys. 82(2) 836-839 July 1997
371. Z.L.Wang, T.S.Ahmadi, M. A.El-Sayed, "Steps, ledges and kinks on the surfaces of platinum nanoparticles of different shapes", Surface Science, 380, 302-310 (1997)
372. J.Wang, S.Yoo, L. Song, M.A. El-Sayed, "Molecular Mechanism of the Differential Photoelectric Response of Bacteriorhodopsin" J.Phys.Chem.B, 101(17) 3420-3423 (1997)
373. S.L.Logunov, T.S.Ahmadi, M.A.El-Sayed, J.T.Khoury, R.L.Whetten, "Electron Dynamics of Passivated Gold Nanocrystals Probed by Subpicosecond Transient Absorption Spectroscopy", J.PhysChem.B, 101(19) 3713-3719 (1997)
374. Stephan L. Logunov and Mostafa A. El-Sayed, "Redetermination of the Quantum Yield of Photoisomerization and Energy Content in the K-Intermediate of Bacteriorhodopsin Photocycle and Its Mutants by the Photoacoustic Technique", J.Phys.Chem.B, 101, (33), 6629-6633 (1997)

375. Kwang-Woo Jung, Temer S. Ahmadi, and Mostafa A. El-Sayed, “Photofragment Translational Spectroscopy of ICl at 304 nm”, JPhys.Chem.A, 101 (36) 6562-6567 (1997)
376. Ke Zhang, Li Song, Jun Dong, and M. A. El-Sayed “Studies of Cation Binding in ZnCl2-Regenerated Bacteriorhodopsin by X-Ray Absorption Fine Structures: Effects of Removing Water Molecules and Adding Cl- Ions”. BiophysJ., 73, 2097-2105 (1997)
377. Jian-ping Wang, Li Song, Seoung-kyo Yoo, and Mostafa A. El-Sayed, “A comparison of the Photoelectric Current Responses Resulting from the Proton Pumping Process of Bacteriorhodopsin under Pulsed and CW Laser Excitations”, JPhysChem, 101 (49), 10599-10604 (1997)
378. V. Volkov, Yu.P.Svirko, V.F.Kamalov, L.Song, and M.A. El-Sayed, “Optical Rotation of the Second Harmonic Radiation from Retinal in Bacteriorhodopsin Monomers in Langmuir-Blodgett Film: Evidence for Nonplanar Retinal Structure”, Biophys.J.l, 73, 3164-3170 (1997)
379. Kwang-Woo Jung, Temer S. Ahmadi, and Mostafa A. El-Sayed, “Photofragment Translational Spectroscopy of CH2I2 at 304 nm: Polarization Dependence and Energy Partitioning”, Bul.Kor.Chem.Soc, 18 (12), 1274-1280 (1997).
380. S. L. Logunov, T. M. Masciangioli, V. F. Kamalov, and M. A. El-Sayed, “Low Temperature Retinal Photoisomerization Dynamics in Bacteriorhodopsin”, JPhysChem, 102 (13), 2303-2306 (1998)
381. Janet M. Petroski, Zhong L. Wang, Travis C. Green, and Mostafa A. El-Sayed, “Kinetically Controlled Growth and Shape Formation Mechanism of Platinum Nanoparticles”, JPhysChem B, 102 (18) 3316-3320 (1998)
382. S. L. Logunov, T. Green, S. Marguet, M. A. El-Sayed, “Interfacial Carrier Dynamics of Cadmium Sulfide Nanoparticles”, JPhysChem A, 102 (28), 5652-5658 (1998)
383. Zhong L. Wang, Janet M. Petroski, Travis C. Green, and Mostafa A. El-Sayed, “Shape Transformation and Surface Melting of Cubic and Tetrahedral Platinum Nanocrystals”, JPhysChem B, 102 (32), 6145-6151 (1998)
384. R. B. Little, C. Burda, S. Link, S. Logunov, and M. A. El-Sayed, “Charge Separation Effects on the Rate of Nonradiative Relaxation Processes in Quantum Dots-Quantum Well Heteronanostructures”, JPhysChemA, 102 (33) 6581-6584 (1998)
385. Song, Li, El-Sayed, M. A., “Primary Step in Bacteriorhodopsin Photosynthesis: Bond Stretch Rather than Angle Twist of Its Retinal Excited-State Structure”, J. Am. Chem. Soc. Communication, 120 (34), 8889-8890 (1998)
386. Logunov, S. L., Masciangioli, T. M., El-Sayed, M. A., “Quantitative Determination of the Protein Catalytic Efficiency for the Retinal Excited-State Decay in Bacteriorhodopsin”, JPhysChemB, 102 (41), 8109-8112 (1998).
387. Song, Li, Liu, Suyi, Zhelyaskov, Valentin, El-Sayed, M. A., "Application of Liquid Waveguide to Raman Spectroscopy in Aqueous Solution", Applied Spectroscopy, 52 (10), 1364-1367 (1998)
388.Mona B. Mohamed, Kamal Z. Ismail, Stephan Link, and Mostafa A. El-Sayed, "Thermal Reshaping of Gold Nanorods in Micelles", JPhysChemB, 102 (47), 9370-9374 (1998).
389. Jianping Wang, Li Song, Bingsuo Zou, and Mostafa A. El-Sayed, "Time-resolved Fourier-transform infrared and visible luminescence spectroscopy of photoexcited porous silicon", Physical Review B, 59 (7), 5026-5031 (1999).
390. S. Link, C. Burda, M. B. Mohamed, B. Nikoobakht, and M. A. El-Sayed, "Laser Photothermal Melting and Fragmentation of Gold Nanorods: Energy and Laser Pulse- Width Dependence", JPhysChemA, 103 (9), 1165-1170 (1999).
391. B. S. Zou, R. B. Little, J. P. Wang, M. A. El-Sayed, "Effect of Different Capping Environments on the Optical Properties of CdS Nanoparticles in Reverse Micelles", Int'l. J. Quantum Chem., 72, 439-450 (1999).

392. C. Burda, T. C. Green, S. Link, and M. A. El-Sayed, "Electron Shuttling Across the Interface of CdSe Nanoparticles Monitored by Femtosecond Laser Spectroscopy", JPhysChemB, 103 (11), 1783-1788 (1999).
393.S. Link, M. B. Mohamed, and M. A. El-Sayed, "Simulation of the Optical Absorption Spectra of Gold Nanorods as a Function of Their Aspect Ratio and the Effect of the Medium Dielectric Constant", JPhysChem B, 103 (16), 3073-3077 (1999).
394. S.Link, Z. L. Wang, and M. A. El-Sayed, "Alloy Formation of Gold-Silver Nanoparticles and the Dependence of the Plasmon Absorption on Their Composition", JPhysChemB, 103 (18), 3529-3533 (1999).
395. Jianping Wang and Mostafa A. El-Sayed, "Temperature jump induced secondary structural changes of the membrane protein Bacteriorhodopsin in the premelting temperature region: a nanosecond time-resolved FTIR study", Biophysical J, 76 (5), 2777-2783 (1999).
396.Stephan Link and Mostafa A. El-Sayed, "Size and Temperature Dependence of the Plasmon Absorption of Colloidal Gold Nanoparticles", JPhysChemB, 103 (21), 4212- 4217 (1999).
397. A. Ebong, P. Doshi, S. Narasimha, A. Rohatgi, J. Wang, and M. A. El-Sayed, "The Effect of Low and High Temperature Anneals on the Hydrogen Content and Passivation of Si Surface Coated with SiO2 and SiN Films", J. of The Electrochemical Soc., 146 (5) 1921-1924 (1999).
398. S. Link, C. Burda, Z. L. Wang, and M. A. El-Sayed, "Electron dynamics in gold and gold-silver alloy nanoparticles: The influence of a nonequilibrium electron distribution and the size dependence of the electron-phonon relaxation", J. Chem. Physics, 111 (3) 1255-1264 (1999).
399. Jianping Wang, Bingsuo Zou, Mostafa A. El-Sayed, "Comparison between the polarized Fourier-transform infrared spectra of aged porous silicon and amorphous silicon dioxide films on Si (100) surface", J. Molecular Structure, 508, 87-96 (1999).
400. Z.L. Wang, M.B. Mohamed, S. Link, M. A. El-Sayed, "Crystallographic facets and shapes of gold nanorods of different aspect ratios", Surface Science, 440, L809-L814 (1999).
401.Stephan Link and Mostafa A. El-Sayed, "Spectral Properties and Relaxation Dynamics of Surface Plasmon Electronic Oscillations in Gold and Silver Nanodots and Nanorods", JPhysChemB, 103 (40), 8410-8426 (1999) (Feature Article).
402.Mona B. Mohamed, Zhong L. Wang, and Mostafa A. El-Sayed, "Temperature- Dependent Size-Controlled Nucleation and Growth of Gold Nanoclusters", J. Phys Chem A, 103 (49), 10255-10259 (1999).
403. C. Burda, S. Link, T. C. Green, and M. A. El-Sayed, "New Transient Absorption Observed in the Spectrum of Colloidal CdSe Nanoparticles Pumped with High-Power Femtosecond Pulses", JPhysChemB, 103 (49), 10775-10780 (1999).
404. S. Link, C. Burda, B. Nikoobakht, M. A. El-Sayed, "How long does it take to melt a gold nanorod? A femtosecond pump-probe absorption spectroscopic study", Chemical Physics Letters, 315, 12-18 (1999).
405. S. Link, C. Burda, M. B. Mohamed, B. Nikoobakht, and M. A. El-Sayed, "Femtosecond transient-absorption dynamics of colloidal gold nanorods: Shape independence of the electron-phonon relaxation time," Physical Review B, 61 (9), 6086- 6090 (2000).
406. Mona B. Mohamed, Victor Volkov, Stephan Link, Mostafa A. El-Sayed, "The 'lightning' gold nanorods: fluorescence enhancement of over a million compared to the gold metal," Chem. Phys. Lett., 317, 517-523 (2000).
407. Jianping Wang and Mostafa A. El-Sayed, "The Effect of Protein Conformation Change from áII to áI on the Bacteriorhodopsin Photocycle", Biophysical Journal, 78, 2031-2036 (2000).

408. C. Burda and M. A. El-Sayed, "High-density femtosecond transient absorption spectroscopy of semiconductor nanoparticles.A tool to investigate surface quality", Pure and Applied Chemistry, 72, 165-177 (2000).
409. Jianping Wang and Mostafa A. El-Sayed, "Proton Polarizability of Hydrogen- Bonded Network and its Role in Proton Transfer in Bacteriorhodopsin", J. Phys. Chem.A, 104 (18), 4333-4337 (2000).
410. Z. L. Wang, R. P. Gao, B. Nikoobakht, and M. A. El-Sayed, "Surface Reconstruction of the Unstable {110} Surface in Gold Nanorods", J. Phys. Chem. B, 104, (23) 5417-5420 (2000).
411. S. Link, C. Burda, B. Nikoobakht, and M. A. El-Sayed, "Laser-Induced Shape Changes of Colloidal Gold Nanorods Using Femtosecond and Nanosecond Laser Pulses", J. Phys. Chem. B, 104, (26) 6152-6163 (2000).
412. C. Burda, M. H. Abdel-Kader, S. Link, and M. A. El-Sayed, "Femtosecond Dynamics of a Simple Merocyanine Dye: Does Deprotonation Compete with Isomerization?", J. Am. Chem. Soc., 122, (28) 6720-6726 (2000).
413. Yin Li, Xiaoyong M. Hong, David M. Collard, and Mostafa A. El-Sayed, "Suzuki Cross-Coupling Reactions Catalyzed by Palladium Nanoparticles", Organic Letters, 2 (15), 2385-2388 (2000).
414.Stephan Link and Mostafa A. El-Sayed, "Shape and size dependence of radiative, non-radiative and photothermal properties of gold nanocrystals", Int. Reviews in Physical Chemistry, 19 (3) 409-453 (2000).
415. Stephan Link, Zhong L. Wang, and Mostafa A. El-Sayed, "How Does a Gold Nanorod Melt?" J. Phys. Chem. B, 104 (33), 7867-7870 (2000).
416. B.Nikoobakht, Z. L. Wang, and M. A. El-Sayed, "Self-Assembly of Gold Nanorods", J. Phys. Chem. B., 104 (36), 8635-8640 (2000).
417. Tina Masciangioli, Savitha Devanathan, Michael A. Cusanovich, Gordon Tollin and Mostafa A. El-Sayed, "Probing the Primary Event in the Photocycle of Photoactive Yellow Protein Using Photochemical Hole-burning Technique", Photochemistry and Photobiology, 72(5), 639-644 (2000).
418. Yin Li, Janet Petroski, and Mostafa A. El-Sayed, "Activation Energy of the Reaction between Hexacyanoferrate (III) and Thiosulfate Ions Catalyzed by Platinum Nanoparticles", J. Phys. Chem. B, 104 (47), 10956-10959 (2000).
419. Bingsuo Zou, Jianping Wang, Chao Liu, John Z. Zhang, and Mostafa A. El-Sayed, "Origin of emission from porous silicon: Temperature-dependence correlation with proton conductivity", Phys. Rev. B, 62 (24), 595-599 (2000).
420.S. Link and M. A. El-Sayed, "Spectroscopic determination of the melting energy of a gold nanorod", J. Chem. Phys., 114 (5), 2362-2368 (2000).
421. Jianping Wang and Mostafa A. El-Sayed, "Time-Resolved Fourier Transform Infrared Spectroscopy of the Polarizable Proton Continua and the Proton Pump Mechanism of Bacteriorhodopsin", Biophysical Journal, 80, 961-971 (2001).
422. Reginald B. Little, Mostafa A. El-Sayed, Garnett W. Bryant and Susan Burke, "Formation of quantum-dot quantum-well heteronanostructures with large lattice mismatch: ZnS/CdS/ZnS", Journal of Chemical Physics, 114 (4), 1813-1822 (2001).
423. Mostafa A. El-Sayed "Some Interesting Properties of Metals Confined in Time and Nanometer Space of Different Shapes", Acc. Chem. Research, 34 (4), 257-264 (2001).
424. C. Burda, T. C. Green, S. Link and M. A. El-Sayed, "Femtosecond interfacial electron transfer dynamics of CdSe semiconductor nanoparticles", Mater. Res. Soc. Symp.Proc., 536, 419-424 (1999).

425. C. Landes, C. Burda, M. Braun, and M. A. El-Sayed, "Photoluminescence of CdSe Nanoparticles in the Presence of a Hole Acceptor: n-Butylamine", J. Phys. Chem. B, 105 (15), 2981-2986 (2001).
426. Jianping Wang and Mostafa A. El-Sayed, "The Effect of Metal Cation Binding on the Protein, Lipid and Retinal Isomeric Ratio in Regnerated Bacteriorhodopsin of Purple Membrane", Photochemistry and Photobiology, 73 (5), 564-571 (2001).
427.Janet M. Petroski, Travais C. Green, and Mostafa A. El-Sayed, "Self-Assembly of Platinum Nanoparticles of Various Size and Shape", J. Phys. Chem.A, 105 (23), 5542- 5547 (2001).
428. Markus Braun, Clemens Burda, and Mostafa A. El-Sayed, "Variation of the Thickness and Number of Wells in the CdS/HgS/CdS Quantum Dot Quantum Well System", J. Phys. Chem A, 105 (23), 5548-5551 (2001).
429. Markus Braun, Clemens Burda, Mona Mohammed, And Mostafa El-Sayed, "Femtosecond time- resolved electron-hole dynamics and radiative transitions in the double-layer quantum well of the Cds/(HgS)2/CdS quantum-dot-quantum-well nanoparticle", Physical Review B, 64, 035317-1 - 035317-7 (2001).
430. S. L. Logunov, V. V. Volkov, Markus Braun, and M. A. El-Sayed, "The relaxation dynamics of the excited electronic states of retinal in bacteriorhodopsin by two-pump- probe femtosecond studies", Proc. Natl. Acad. Sci. USA, 98 (15), 8475 – 8479 (2001).
431. Mona B. Mohamed, Temer S. Ahmadi, Stephan Link, Markus Braun and Mostafa A, El-Sayed, "Hot electron and phonon dynamics of gold nanoparticles embedded in a gel matrix", Chem. Phys. Letters, 343, 55-63 (2001).
432. Yin Li and Mostafa A. El-Sayed, "The Effect of Stabilizers on the Catalytic Activity and Stability of Pd Colloidal Nanoparticles in the Suzuki Reactions in Aqueous Solution", J. Phys. Chem. B, 105 (37), 8939-8943 (2001).
433. Colin D. Heyes and Mostafa A. El-Sayed, "Effect of Temperature, pH, and Metal Ion Binding on the Secondary Structure of Bacteriorhodopsin: FT-IR Study of the Melting and Premelting Transition Temperatures", Biochemistry, 40 (39), 11819-11827 (2001).
434. Babak Nikoobakht and Mostafa A. El-Sayed, "Evidence for Bilayer Assembly of Cationic Surfactants on the Surface of Gold Nanorods", Langmuir, 17 (20), 6368-6374 (2001).
435. C. Landes, M. Braun, C. Burda, and M. A. El-Sayed, "Observation of Large Changes in the Band Gap Absorption Energy of Small CdSe Nanoparticles Induced by the Adsorption of a Strong Hole Acceptor", NanoLetters, 1 (11), 667-670 (2001).
436. Christy F. Landes, Markus Braun, and Mostafa A. El-Sayed, "On the Nanoparticle to Molecular Size Transition: Fluorescence Quenching Studies", J. Phys. Chem. B, 105 (43), 10554-10558 (2001).
437. Jianping Wang, Daoji Gan, L. Andrew Lyon, and Mostafa A. El-Sayed, "Temperature-Jump Investigations of the Kinetics of Hydrogel Nanoparticle Volume Phase Transitions", J. Am. Chem. Soc., 123 (45), 11284-11289 (2001).
438. Jianping Wang, Yin Li, Xiaoyong Hong, and Mostafa A. El-Sayed, "Direct observation of charge-transfer dynamics in a conjugated conducting polymerpoly(3- octylthiophene)-fullerene composite by time-resolved infrared spectroscopy", Physical Review B, 64, 235413-1 – 235413-5 (2001).
439. Jianping Wang, Colin D. Heyes, and Mostafa A. El-Sayed, "Refolding of Thermally Denatured Bacteriorhodopsin in Purple Membrane", J. Phys. Chem. B, 106 (3), 723-729 (2002).
440. Stephan Link, Akihiro Furube, Mona B. Mohamed, Tsuyoshi Asahi, Hiroshi Masuhara, and Mostafa A. El-Sayed, "Hot Electron Relaxation Dynamics of Gold Nanoparticles Embedded in MgSO4 Powder Compared to Solution: The Effect of the Surrounding Medium", J. Phys. Chem. B, 106 (5), 945-955 (2002).

441. Jung Whan Yoo, David Hathcock, and Mostafa A. El-Sayed, "Characterization of Pt Nanoparticles Encapsulated in Al2O3 and Their Catalytic Efficiency in Propene Hydrogenation", J. Phys. Chem. A,106 (10), 2049-2054 (2002).
442. Stephan Link, Andrew Beeby, Simon FitzGerald, Mostafa A. El-Sayed, T. Gregory Schaaff, and Robert L. Whetten, "Visible to Infrared Luminescence from a 28-Atom Gold Cluster", J. Phys. Chem. B, 106 (13), 3410-3415 (2002).
443. Babak Nikoobakht, Clemens Burda, Markus Braun, Man Hun, and Mostafa A. El- Sayed, "The Quenching of CdSe Quantum Dots Photoluminescence by Gold Nanoparticles in Solution", Photochemistry and Photobiology, 75 (6), 591-597 (2002).
444. Stephan Link, Mostafa A. El-Sayed, T. Gregory Schaaff, Robert L. Whetten, "Transition from nanoparticle to molecular behavior: a femtosecond transient absorption study of a size-selected 28 atom gold cluster", Chemical Physics Letters, 356, 240-246 (2002).
445. Markus Braun, Stephan Link, Clemens Burda, Mostafa El-Sayed, "Transfer times of electrons and holes across the interface in CdS/HgS/CdS quantum dot quantum well nanoparticles", Chemical Physics Letters, 361, 446-452 (2002).
446. C. Landes and M. A. El-Sayed, "Thermodynamic and Kinetic Characterization of the Interaction between N-Butylamine and ~1nm CdSe Nanoparticles", J. Phys. Chem. A, 106 (33), 7621-7627(2002).
447. Bingsuo Zou, Jianping Wang, Mostafa A. El-Sayed, "The correlation between emission in freshly prepared porous silicon and the carrier density in silicon wafer", Asian Journal of Spectroscopy, 6 (1), (2002).
448. Clemens Burda, Stephan Link, Mona B. Mohamed, Mostafa El-Sayed, "The pump power dependence of the femtosecond relaxation of CdSe nanoparticles observed in the spectral range from visible to infrared", Journal of Chemical Physics, 116 (9), 3828-3833 (2002).
449. Yin Li, Edna Boone, Mostafa A. El-Sayed, "Size Effects of PVP-Pd Nanoparticles on the Catalytic Suzuki Reactions in Aqueous Solution", Langmuir, 18 (12), 4921-4925 (2002).
450. Colin D. Heyes, Mostafa A. El-Sayed, "The role of the native lipids and lattice structure in bacteriorhodopsin protein conformation and stability as studied by temperature-dependent Fourier transform-infrared spectroscopy", Journal of Biological Chemistry, 277 (33), 29437-29443 (2002).
451. C. Landes, M. Braun, M. A. El-Sayed, "The effect of surface adsorption on the hyper-Rayleigh scattering of large and small CdSe nanoparticles", Chem. Phys. Letters, 363 (5,6), 465-470 (2002).
452. Jianping Wang, Stephan Link, Colin D. Heyes, Mostafa A. El-Sayed, "Comparison of the dynamics of the primary events of bacteriorhodopsin in its trimeric and monomeric states", Biophysical Journal, 83 (3), 1557-1566 (2002).
453. Jianping Wang, Mostafa A. El-Sayed, "Time-resolved long-lived infrared emission from bacteriorhodopsin during its photocycle", Biophysical Journal, 83 (3) 1589-1594 (2002).
454. Colin D. Heyes, Jianping Wang, Laurie S. Sanii, Mostafa A. El-Sayed, "Fourier transform infrared study of the effect of different cations on bacteriorhodopsin protein thermal stability", Biophysical Journal, 82 (3), 1598-1606 (2002).
455. Babak Nikoobakht, Jianping Wang, Mostafa A. El-Sayed, "Surface-enhanced Raman scattering of molecules adsorbed on gold nanorods: off-surface plasmon resonance condition", Chem. Phys. Lett., 366, 17-23 (2002).
456. C. Landes, M. Braun, M.A. El-Sayed, "The effect of surface adsorption on the hyper-Rayleigh scattering of large and small CdSe nanoparticles", Chem. Phys. Lett., 363, 465-470 (2002).
457.Stephan Link and Mostafa A. El-Sayed, "Room temperature optical gain in CdSe nanorod solutions", Journal of Applied Physics, 92 (2), 6799-6803 (2002).

458. Markus Braun, Stephan Link, Clemens Burda, and Mostafa El-Sayed, "Determination of the localization times of electrons and holes in the HgS well in a Cd/HgS/CdS quantum dot-quantum well nanoparticle", Physical Review B, 66, 205312/1-205312-5 (2002)
459. Jung Whan Yoo, David J. Hathcock, Mostafa A. El-Sayed, "Propene hydrogenation over truncated octahedral Pt nanoparticles supported on alumina", Journal of Catalysis, 214, 1-7 (2003)
460. Qusai Darugar, Christy Landes, Stephan Link, Alexander Schill, Mostafa A. El- Sayed, "Why is the thermalization of excited electrons in semiconductor nanoparticles so rapid? Studies on CdSe nanoparticles", Chem. Phys. Letters, 373, 284-291 (2003)
461. Stephan Link, David J. Hathcock, Babak Nikoobakht, Mostafa A. El-Sayed, "Medium Effect on the Electron Cooling Dynamics in Gold Nanorods and Truncated Tetrahedra", Advanced Materials, 15, 5 (2003)
462. Stephan Link, Mostafa A. El-Sayed, "Optical Properties and Ultrafast Dynamics of Metallic Nanocrysals", Annual Review Phys. Chem., 54, 331-66 (2003)
463. Radha Narayanan, Mostafa A. El-Sayed, " Effect of Catalysis on the Stability of Metallic Nanoparticles: Suzuki Reaction Catalyzed by PVP-Palladium Nanoparticles", Journal of the American Chemical Society, 125 (27), 8340-8347, (2003)
464. Radha Narayanan, Mostafa A. El-Sayed, "Effect of Catalytic Activity on the Metallic Nanoparticle Size Distribution: Electron-Transfer Reaction between Fe(CN)6 and Thiosulfate Ions Catalyzed by PVP-Platinum Nanoparticles", Journal of Physical Chemistry B, Vol. 107, Number 45, 12416-12424, (2003)
465. Colin D. Heyes, Mostafa A. El-Sayed,"Thermal Properties of Bacteriorhodopsin", Journal of Physical Chemistry B, Vol. 107, 44, 12045-12053, (2003).
466. Janet Petroski, Mostafa A. El-Sayed, "FTIR Study of the Adsorption of the Capping Material to Different Platinum Nanoparticle Shape", J. Phys. Chem A, 107, 8371-8375, (2003).
467. Babak Nikoobakht, Mostafa A. El-Sayed, "Preparation and Growth Mechanism of Gold Nanorods (NRs) Using Seed-Mediated Growth Method," Chem. Mater, 15, 1957- 1962, (2003).
468. Oleg P. Varnavski, Mona B. Mohamed, Mostafa A. El-Sayed, Theodore Goodson III, "Relative Enhancement of Ultrafast Emission in Gold Nanorods," J. Phys. Chem. B, 107, 3101-3104, (2003).
469. Babak Nikoobakht, Mostafa A. El-Sayed, "Surface-Enhanced Raman Scattering Studies on Aggregated Gold Nanorods," J. Phys. Chem A, 107, 3372-3378, (2003).
470.Colin D. Heyes and Mostafa A. El-Sayed, "Proton Transfer Reactions in Native and Deionized Bacteriorhodopsin Upon Delipidation and Monomerization," Biophysical Journal, 85, 426-434, (2003).
471.Colin D. Heyes, Keith B. Reynolds, Mostafa A. El-Sayed, "Eu3+ Binding to Europium-Regenerated Bacteriorhodopsin upon Delipidation and Monomerization", FEBS Letters, 562 (2004) 207-210.
472. Radha Narayanan, Mostafa A. El-Sayed, "Effect of Nanocatalysis in Colloidal Solution on the Tetrahedral and Cubic Nanoparticle Shape: Electron-Transfer Reaction Catalyzed by Platinum Nanoparticles," J. Phys. Chem B, 108, 18, 5726-5733 (2004).
473. Radha Narayanan, Mostafa A. El-Sayed, "Changing Catalytic Activity During Colloidal Platinum Nanocatalysis Due to Shape Changes: Electron-Transfer Reaction," Journal of the American Chemical Society, 126(23), 7194-7195 (2004).
474. Mostafa A. El-Sayed, "Small is Different: Shape-, Size-, and Composition- Dependent Properties of Some Colloidal Semiconductor Nanocrystals," Accounts of Chemical Research, 37 (5), 326-333, (2004).

475. Narayanan, R.; El-Sayed, M. A., "Shape-Dependent Catalytic Activity of Platinum Nanoparticles in Colloidal Solution", Nano Lett., 4, 7, 1343-1348, (2004).
476. Wenyu Huang; Wei Qian; Mostafa A. El-Sayed, "Coherent Vibrational Oscillation in Gold Prismatic Monolayer Periodic Nanoparticle Arrays", Nano Lett, 4, (9), 1741-1747, (2004).
477. Maillard, Mathieu; Pileni, Marie-Paule; Link, Stephan; El-Sayed, Mostafa A., "Picosecond Self-Induced Thermal Lensing from Colloidal Silver Nanodisks, J. Phys. Chem. B 108 (17), 5230-5234, (2004).
478. Maillard, Mathieu; Pileni, Marie-Paule; Link, Stephan; El-Sayed, Mostafa A., "Picosecond Self-Induced Thermal Lensing from Colloidal Silver Nanodisks. [Erratum to Document Cited in CA140:414214], J. Phys. Chem. B 108 (31)m 11876, (2004).
479. Link, Stephan; El-Sayed, Mostafa A., "Optical Spectroscopy of Surface Plasmons in Metal Nanoparticles"Optical Engineering, 87(Semiconductor and Metal Nanocrystals) 421-452, (2004).
480. R.M. Donlan; J.A. Piede; C.D. Heyes; L. Sanii; R. Murga; P. Edmonds; I. El- Sayed; M.A. El-Sayed, "Model System for Growing and Quantifying Streptococcus Pneumoniae Biofilms in Situ and in Real Time," Appl. Environ. Microbiol., 70(8), 4980- 4988, (2004).
481. Jung Whan Yoo; Sung-Min Lee; Hyung-Tae Kim; M.A. El-Sayed, "Shape Control of Platinum Nanoparticles by Using Different Capping Organic Materials," Bull. Korean Chem. Soc., 25, 395-396 (2004).
482. Jung Whan Yoo; Sung-Min Lee; Hyung-Tae Kim; M.A. El-Sayed, "Propylene Hydrogenation Over Cubic Pt Nanoparticles Deposited on Alumina," Bull. Korean Chem. Soc., 25, 843-846, (2004).
483. Garczarek, Florian; Wang, Jianping; El-Sayed, Mostafa A.; Gerwert, Klaus, "The Assignment of the Different Infrared Continuum Absorbance Changes Observed in the 3000-1800-cm-1 Region During the Bacteriorhodopsin Photocycle," Biophysical Journal 87 (4), 2676-2682, (2004).
484. Schill, Alexander W.; El-Sayed, Mostafa A., "Wavelength-Dependent Hot Electron Relaxation in PVP Capped CdS/HgS/CdS Quantum Dot Quantum Well Nanocrystals," Journal of Physical Chemistry B, 108 (36), 13619-13625, (2004).
485. Susie Eustis; Galina Krylova; Anna Eremenko; Natalie Smirnova; Alexander W. Schill; Mostafa El-Sayed, "Growth and Fragmentation of Silver Nanoparticles in their Synthesis with a fs Laser and CW Light by Photo-Sensitization with Benzophenone", Photochemical & Photobiological Sciences, 4, 154-159 (2005).
486. Narayanan, Radha; El-Sayed, Mostafa A., "Effect of Colloidal Nanocatalysis on the Metallic Nanoparticle Shape: The Suzuki Reaction," Langmuir, 21 (5), 2027-2033; (2005)
487. El-Sayed, Ivan; Huang, Xiaohua; El-Sayed, Mostafa A., "Surface Plasmon Resonance Scattering and Absorption of anti-EGFR Antibody Conjugated Gold Nanoparticles in Cancer Diagnostics; Applications in Oral Cancer," Nano Letters 4 (5), 829-834, (2005).
488. Susie Eustis, Hsan-Yin Hsu, and Mostafa A. El-Sayed, "Gold Nanoparticle Formation from Photochemical Reduction of Au3+ by Continuous Excitation in Colloidal Solutions. A Proposed Molecular Mechanism," J. Phys. Chem. B, 109, 11, 4811-4815, (2005).
489. Radha Narayanan; Mostafa A. El-Sayed, "FTIR Study of the Mode of Binding of the Reactants on the Pd Nanoparticle Surface during the Catalysis of the Suzuki Reaction," J. Phys. Chem. B, 109, 10, 4357-4360, (2005).
490. Burda, C.; Chen, X.; Narayanan, R.; El-Sayed, M.A., "The Chemistry and Properties of Nanocrystals of Different Shapes", Chem. Rev. 105 (4), 1025-1102, (2005) Invited Review Article.

491. Laurie S. Sanii; Alex W. Schill; Cristin E. Moran; and Mostafa A. El-Sayed, "The Protonation-Deprotonation Kinetics of the Protonated Schiff Base in Bicelle Bacteriorhodopsin Crystals", Biophysical Journal 89, 444-451 (2005).
492. Radha Narayanan and Mostafa A. El-Sayed, "Catalysis with Transition Metal Nanoparticles in Colloidal Solution: Nanoparticle Shape Dependence and Stability", J. Physical Chem B. Feature Article 109, 26, 12663-12676 (2005).
493. Radha Narayanan and Mostafa A. El-Sayed, "Carbon-Supported Spherical Palladium Nanoparticles as Potential Recyclable catalysts for the Suzuki Reaction", Journal of Catalysis 234, 2, 348-355, (2005).
494. Susie Eustis and Mostafa El-Sayed, "Aspect Ratio Dependence of the Enhanced Fluorescence Intensity of Gold Nanorods: Experimental and Simulation Study," Journal of Phys. Chem. B, 109 (34), 16350-16356 (2005).
495. M.A. El-Sayed, "Chemistry Curricula in the Future", Chemical & Engineering News, 83, 20, 6-6, (2005).
496. Laurie S. Sanii; Mostafa A. El-Sayed, "Partial Dehydration of the Retinal Binding Pocket and Proof for Photochemical Deprotonation of the Retinal Schiff Base in Bicelle Bacteriorhodopsin Crystals", Photochemistry and Photobiology, 81 (6), 1356-1360 (2005).
497. Xiaohua Huang; Ivan H. El-Sayed; Xiaobing Yi; Mostafa A. El-Sayed, "Gold Nanoparticles: Catalyst for the Oxidation of NADH to NAD", Journal of Photochemistry and Photobiology B, 81 (2), 76-83, (2005).
498. El-Sayed, Ivan; Huang, Xiaohua; El-Sayed, Mostafa A. "Selective Laser Photo- Thermal Therapy of Epithelial Carcinoma Using Anti-EGFR Antibody Conjugated Gold Nanoparticles", Cancer Letters, 239 (1), 129-135, (2006).
499. Link, S., El-Sayed, M.A., Mohamed, M. B., "Simulation of the optical absorption spectra of gold nanorods as a function of their aspect ratio and the effect of the medium dielectric constant (vol 103B, pg 3073, 1999)", Journal of Physical Chemistry B, 109 (20), 10531-10532, (2005).
500. Huang, Wenyu; Qian, Wei; El-Sayed, Mostafa A., "The optically detected coherent lattice oscillations in silver and gold monolayer periodic nanoprism arrays: The effect of interparticle coupling", Journal of Physical Chemistry B, 109 (40), 18881-18888, (2005).
501. Huang, Wenyu; Qian, Wei; El-Sayed, Mostafa A., "Photothermal reshaping of prismatic Au nanoparticles in periodic monolayer arrays by femtosecond laser pulses," Journal of Applied Physics, 98 (11), 114301/1-114301/8, (2005).
502. Narayanan, R; El-Sayed, Mostafa A., "Raman studies on the interaction of the reactants with the platinum nanoparticle surface during the nanocatalyzed electron transfer reaction", Journal of Physical Chemistry B, 109 (39), 18460-18464, (2005).
503. Narayanan R; El-Sayed M. A., "Effect of colloidal catalysis on the nanoparticle size distribution: Dendrimer-Pd vs PVP-Pd nanoparticles catalyzing the Suzuki coupling reaction," J. Phys. Chem. B, 108 (25): 8572-8580, (2004).
504. Kyeong-Seok Lee and Mostafa A. El-Sayed, "Dependence of the enhanced optical scattering efficiency relative to that of absorption for gold metal nanorods on aspect ratio, size, end-cap shape, and medium refractive index", Journal of Physical Chemistry B, 109 (43), 20331-20338, (2005).
505. Wenyu Huang, Wei Qian, Mostafa A. El-Sayed, "Optically detected coherent picosecond lattice oscillations in two dimensional arrays of gold nanocrystals of different sizes and shapes induced by femtosecond laser pulses" (ed. Stockman, M. I..) 592701 (SPIE, 2005).
506.Laurie S. Sanii and Mostafa A. El-Sayed"Effect of Crystallization on the Proton Pump Function of bR", ISRAPS BULLETIN, 18 (1&2), 52-57, (2006).

507. Prashant K.Jain; Wei Qian, Mostafa A. El-Sayed, "Ultrafast Electron Relaxation Dynamics in Coupled Metal Nanoparticles in Aggregates", Journal of Physical Chemistry B, 110 (1), 136-142 (2006).
508.Darugar, Qusai; Qian, Wei; El-Sayed, Mostafa A.; Pileni, Marie-Paule, Size- Dependent Ultrafast Electronic Energy Relaxation and Enhanced Fluorescence of Copper Nanoparticles," Journal of Physical Chemistry B, 110 (1), 143-149 (2006).
509. Susie Eustis and Mostafa. A. El-Sayed "Why gold nanoparticles are more precious than pretty gold: Noble metal surface plasmon resonance and its enhancement of the radiative and nonradiative properties of nanocrystals of different shapes," Chemical Society Reviews, 35 (3), 209-217, (2006).
510. Huang, X., El-Sayed, I. H., Qian, W. and El-Sayed, M. A. "Cancer Cell Imaging and Photothermal Therapy in the Near-Infrared Region by Using Gold Nanorods," Journal of the American Chemical Society, 128 (6), 2115-2120, (2006).
***(MOST CITED 2006 JACS ARTICLE !!! - as of Mar 31, 2008)
511. Prashant K. Jain, Wei Qian and Mostafa A. El-Sayed, M. A. "Ultrafast Cooling of Photoexcited Electrons in Gold Nanoparticle-Thiolated DNA Conjugates Involves the Dissociation of the Gold-Thiol Bond," Journal of the American Chemical Society, 128 (7), 2426-2433, (2006).
512. Prashant K. Jain, Kyeong-Seok Lee, Ivan H.El-Sayed and Mostafa A. El-Sayed, "Calculated Absorption and Scattering Properties of Gold Nanoparticles of Different Size, Shape, and Composition: Applications in Biological Imaging and Biomedicine," Journal of Physical Chemistry B, 110 (14), 7238-7248, (2006).
*** #1 most cited JPCB article of 2006 to date (Oct 27, 2009) ***
513. Huang, Xiaohua, Jain Prashant, K., El-Sayed Ivan, H. and El-Sayed Mostafa, A. "Determination of the minimum temperature required for selective photothermal destruction of cancer cells with the use of immunotargeted gold nanoparticles," Photochemistry and Photobiology, 82 (2), 412-417, (2006).
*** #2 most cited Photochemistry and Photobiology article of 2006 to date (Oct 27, 2009) ***
514. Eustis, Susie; El-Sayed, Mostafa A., "Molecular Mechanism of the Photochemical Generation of Gold Nanoparticles in Ethylene Glycol: Support for the Disproportionation Mechanism," Journal of Physical Chemistry B, 110 (29), 14014-14019, (2006).
515. Eustis, Susie; Krylova, Galina; Smirnova, Natalie; Eremenko, Anna; Tabor, Christopher; Huang, Wenyu; El-Sayed, Mostafa A, "Using silica films and powders modified with benzophenone to photoreduce silver nanoparticles," Journal of Photochemistry and Photobiology, A: Chemistry, 181 (2-3), 385-393, (2006).
516. O. P. Varnavski, T. Goodson, III, M. B. Mohamed, M. A. El-Sayed, "Femtosecond excitation dynamics in gold nanospheres and nanorods," Physical Review B, 72, 235405/1-235405/9, (2005).
517. Qusai Darugar, Wei Qian, and Mostafa A. El-Sayed, "Observation of optical gain in solutions of CdS quantum dots at room temperature in the blue region," Applied Physics Letters, 88, 261108, (2006).
518. Alexander W.Schill, Christopher S. Gaddis, Wei Qian, Mostafa A. El-Sayed, Ye Cai, Valerie T. Milam, Kenneth Sandhage, "Ultrafast Electronic Relaxation and Charge- Carrier Localization in CdS/CdSe/CdS Quantum-Dot Quantum-Well Heterostructures," Nano Letters, 6(9), 1940-1949, (2006).
519. Prashant K. Jain, Susie Eustis, Mostafa A. El-Sayed, "Plasmon Coupling in Nanorod Assemblies: Optical Absorption, Discrete Dipole Approximation Simulation, and Exciton-Coupling Model," Journal of Physical Chemistry B, 110(37), 18243-18253 (2006).

*** #12 most cited JPCB article of 2006 to date (Oct 27, 2009) ***
520. Susie Eustis, Mostafa A. El-Sayed, "Determination of the aspect ratio statistical distribution of gold nanorods in solution from a theoretical fit of the observed inhomogeneously broadened longitudinal plasmon resonance absorption spectrum," Journal of Applied Physics, 100(4), 044324/1-044324/7, (2006).
521. Kyeong-Seok Lee and Mostafa A. El-Sayed, "Gold and Silver Nanoparticles in Sensing and Imaging: Sensitivity of Plasmon Response to Size, Shape, and Metal Composition," Journal of Physical Chemistry B, 110(39), 19220-19225, (2006).
(#5 most cited 2006 JPCB article - as of Mar 31, 2008)
522. Wenyu Huang, Wei Qian and Mostafa A. El-Sayed, "Gold Nanoparticles Propulsion from Surface Fueled by Absorption of Femtosecond Laser Pulse at Their Surface Plasmon Resonance," Journal of the American Chemical Society, 128(41), 13330- 13331, (2006).
523. Prashant K. Jain, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Au nanoparticles target cancer," Nano Today (Elsevier), Invited review, 2(1), 18-29, (2007).
*** #1 most cited Nano Today article to date (Oct 27, 2009) ***
524. Huang, Xiaohua; El-Sayed, Ivan H.; Qian, Wei; El-Sayed, Mostafa A. "Cancer Cells Assemble and Align Gold Nanorods Conjugated to Antibodies to Produce Highly Enhanced, Sharp, and Polarized Surface Raman Spectra: A Potential Cancer Diagnostic Marker," Nano Letters, 7(6), 1591-1597, (2007).
525. Tabor, Christopher; Qian, Wei; El-Sayed, Mostafa A. "Dependence of the Threshold Energy of Femtosecond Laser Ejection of Gold Nanoprisms from Quartz Substrates on the Nanoparticle Environment," Journal of Physical Chemistry C, 111(25), 8934-8941, (2007).
526. Nishikiori, Hiromasa; Qian, Wei; El-Sayed, Mostafa A.; Tanaka, Nobuaki; Fujii, Tsuneo. "Change in Titania Structure from Amorphousness to Crystalline Increasing Photoinduced Electron-Transfer Rate in Dye-Titania System," Journal of Physical Chemistry C, 111(26), 9008-9011, (2007).
527. Prashant K. Jain, Wenyu Huang, Mostafa A. El-Sayed, "On the Universal Scaling Behavior of the Distance Decay of Plasmon Coupling in Metal Nanoparticle Pairs: A Plasmon Ruler Equation," Nano Letters, 7(7), 2080-2088 (2007).
528. Wenyu Huang, Wei Qian, Mostafa A. El-Sayed, Yong Ding, Zhong Lin Wang, "Effect of the Lattice Crystallinity on the Electron-Phonon Relaxation Rates in Gold Nanoparticles," Journal of Physical Chemistry C, 111(29),0751-10757, (2007).
529. Prashant K. Jain, Xiaohua Huang, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Review of some surface plasmon resonance-enhanced properties of noble metal nanoparticles and their applications to biosystems," Invited review, Plasmonics Special Issue on Advances in Metal-Molecular interactions, 2(3), 107-118, (2007).
*** #1 most cited Plasmonics article to date (Oct 27, 2009) ***
530. Adegboyega K. Oyelere, Po C. Chen, Xiaohua Huang, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Peptide-Conjugated Gold Nanorods for Nuclear Targeting," Bioconjugate Chemistry, 18(5), 1490 – 1497, (2007).
531. Xiaohua Huang, Wei Qian, Ivan H. El-Sayed, Mostafa A. El-Sayed, "The potential use of the enhanced nonlinear properties of gold nanospheres in photothermal cancer therapy," Lasers in Surgery and Medicine, 39(9), 747 – 753, (2007).
532. Prashant K. Jain, Mostafa A. El-Sayed, "Universal scaling of plasmon coupling in metal nanostructures: Extension from particle-pairs to nanoshells," Nano Letters, 7(9), 2854-2858, (2007).
533. Wenyu Huang, Wei Qian, Prashant K. Jain, Mostafa A. El-Sayed, "The Effect of Plasmon Field on the Coherent Lattice Phonon Oscillation in Electron-Beam Nanofabricated Gold Particle Pairs," Nano Letters, 7(10), 3227 – 3234, (2007).

534. Ivan H. El-Sayed, Xiaohua Huang, Fima Macheret, Joseph Oren Humstoe, Randall Kramer, Mostafa A. El-Sayed, "Effect of plasmonic gold nanoparticles on benign and malignant cellular autofluorescence: A novel probe for fluorescence based detection of cancer," Technology in Cancer Research & Treatment 6, 403-412 (2007).
535. Xiaohua Huang, Prashant K. Jain, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Gold nanoparticles: interesting optical properties and recent applications in cancer diagnostics and therapy," Invited Review, Nanomedicine, 2(5), 681-693, (2007).
*** #1 most cited Nanomedicine article to date (Oct 27, 2009) ***
536. Narayanan, Radha; El-Sayed, Mostafa A., "Catalysis by metallic nanoparticles: the good and the bad," Chimica Oggi 25(1), 84-86, (2007).
537. M. A. Mahmoud, M. A. El-Sayed, "Reaction of Platinum Nanocatalyst with the Ferricyanide Reactant to Produce Prussian Blue Analogue Complexes," Journal of Physical Chemistry C, 111(46), 17180-17183, (2007).
538. Prashant K. Jain and Mostafa A. El-Sayed, "Surface Plasmon Resonance Sensitivity of Metal Nanostructures: Physical Basis and Universal Scaling in Metal Nanoshells," Journal of Physical Chemistry C, 111(47), 17451-17454, (2007).
***(18^{th} most accessed J. Phys. Chem. C article (Oct-Dec) 2007)
539. Prashant K. Jain, Xiaohua Huang, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Review of Some Interesting Surface Plasmon Resonance-enhanced Properties of Noble Metal Nanoparticles and Their Applications to Biosystems," Plasmonics, 2 (3), 107-118 (2007).
540. Arianna Biesso, Wei Qian, Mostafa A. El-Sayed, "Gold nanoparticle plasmonic field effect on the primary step of the other photosynthetic system in nature, bacteriorhodopsin," Journal of the American Chemical Society 130(11), 3258, (2008).
541. Wenyu Huang, Mostafa A. El-Sayed, "Pulsed laser photothermal annealing and ablation of plasmonic nanoparticles," European Physical Journal-Special Topics 153, 223-230, (2008).
542. Wenyu Huang, Mostafa A. El-Sayed, "Photothermally excited coherent lattice phonon oscillations in plasmonic nanoparticles," European Physical Journal-Special Topics 153, 325-333, (2008).
543. Wenu Y. Huang, Wei Qian, Mostafa A. El-Sayed, "Gigahertz optical modulation resulting from coherent lattice oscillations induced by femtosecond laser pumping of 2D photonic crystals of gold-capped polystyrene microspheres," Advanced Materials 20(4), 733-+, (2008).
544. Radha Narayanan, Mostafa A. El-Sayed, "Some aspects of colloidal nanoparticlestability, catalytic activity, and recycling potential," Topics in Catalysis 47, 15-21 (2008).
545. Mahmoud A. Mahmoud, Christopher Tabor, Mostafa A. El-Sayed, Ding, Y. & Zhong Lin Wang, "A new catalytically active colloidal platinum nanocatalyst: The multiarmed nanostar single crystal," Journal of the American Chemical Society 130, 4590-+ (2008).
546. Prashant K. Jain, Mostafa A. El-Sayed, "Surface plasmon coupling and its universal size scaling in metal nanostructures of complex geometry: Elongated particle pairs and nanosphere trimers," Journal of Physical Chemistry C 112, 4954-4960 (2008).
547. Svetlana Neretina, Wei Qian, Erik C. Dreaden, Robert A. Hughes, John S. Preston, Peter Mascher, Mostafa A. El-Sayed, "Plasmon Field Effects on the Nonradiative Relaxation of Hot Electrons in an Electronically Quantized System: CdTe-Au Core-Shell Nanowires," Nano Letters 8(8), 2410-2418 (2008).(link)
548. Erin B. Dickerson, Erik C. Dreaden, Xiaohua Huang, Ivan H. El-Sayed, Hunghao Chu, Sujatha Pushpanketh, John F. McDonald, Mostafa A. El-Sayed, "Gold nanorod assisted near-infrared plasmonic photothermal therapy (PPTT) of squamous cell carcinoma in mice," Cancer Letters 269, 57-66 (2008).(link)

549. Narayanan, R.; Tabor, C.; El-Sayed, M. A., Can the Observed Changes in the Size or Shape of a Colloidal Nanocatalyst Reveal the Nanocatalysis Mechanism Type: Homogeneous or Heterogeneous? Topics in Catalysis 2008, 48, (1-4), 60-74.(link)
550. Xiaohua Huang, Prashant K. Jain, Mostafa A. El-Sayed, "Plasmonic photothermal therapy (PPTT) using gold nanoparticles," Invited Review, Lasers in Medical Science, 23, 217-228 (2008).
*** #1 most cited Lasers in Medical Science article of 2008 to date (Oct 27, 2009) ***
551. Prashant K. Jain, Mostafa A. El-Sayed, "Noble Metal Nanoparticle Pairs: Effect of Medium for Enhanced Nanosensing," Nano Letters, 8 (12), 4347–4352 (2008).
552. Prashant K. Jain, Xiaohua Huang, Ivan H. El-Sayed, Mostafa A. El-Sayed, "Noble Metals on the Nanoscale: Optical and Photothermal Properties and Some Applications in Imaging, Sensing, Biology, and Medicine," Acc. Chem. Res., 41 (12), 1578–1586 (2008).
553. Mahmoud, M. A.; El-Sayed, M. A., Comparative Study of the Assemblies and the Resulting Plasmon Fields of Langmuir-Blodgett Assembled Monolayers of Silver Nanocubes and Gold Nanocages.Journal of Physical Chemistry C, 112(37), 14618- 14625 (2008).
554. Burgin, J.; Langot, P.; Del Fatti, N.; Vallee, F.; Huang, W.; El-Sayed, M. A., Time- Resolved Investigation of the Acoustic Vibration of a Single Gold Nanoprism Pair.Journal of Physical Chemistry C, 112(30), 11231-11235 (2008).
555. Neretina, S.; Qian, W.; Dreaden, E. C.; El-Sayed, M. A.; Hughes, R. A.; Preston, J. S.; Mascher, P., Exciton Lifetime Tuning by Changing the Plasmon Field Orientation with Respect to the Exciton Transition Moment Direction: CdTe-Au Core-Shell Nanorods. Nano Letters2009, 9, (3), 1242-1248.(link)
556. Tabor, C.; Murali, R.; Mahmoud, M.; El-Sayed, M. A., On the Use of Plasmonic Nanoparticle Pairs As a Plasmon Ruler: The Dependence of the Near-Field Dipole Plasmon Coupling on Nanoparticle Size and Shape. Journal of Physical Chemistry A 2009, 113, (10), 1946-1953.(link)
557. Mahmoud, M. A.; Tabor, C. E.; El-Sayed, M. A., Surface-Enhanced Raman Scattering Enhancement by Aggregated Silver Nanocube Monolayers Assembled by the Langmuir-Blodgett Technique at Different Surface Pressures. Journal of Physical Chemistry C, 113 (14), 5493–5501 (2009).
558. Talaat, H.; Abdallah, T.; Mohamed, M. B.; Negm, S.; El-Sayed, Mostafa A., The sensitivity of the energy band gap to changes in the dimensions of the CdSe quantum rods at room temperature: STM and theoretical studies.Chemical Physics Letters, 473(4-6), 288-292 (2009).
559. Wang, Jianping; El-Sayed, Mostafa A.Rapid Thermal Tuning of Chromophore Structure in Membrane Protein.Journal of Physical Chemistry B, 113(13), 4184-4186 (2009).
560. Yen, C. W.; Mahmoud, M. A.; El-Sayed, M. A., Photocatalysis in Gold Nanocage Nanoreactors.Journal of Physical Chemistry A, 113(16), 4340-4345 (2009).
561. Biesso, Arianna; Qian, Wei; Huang, Xiaohua; El-Sayed, Mostafa A., Gold Nanoparticles Surface Plasmon Field Effects on the Proton Pump Process of the Bacteriorhodopsin Photosynthesis.Journal of the American Chemical Society, 131(7), 2442-2443 (2009).
562. Mahmoud, M. A., El-Sayed, M.A., Aggregation of gold Nanoframes reduces, rather than enhances SERS efficiency due to the tradeoff of the inter- and intra particle plasmonic fields. NanoLetters,9 (8), 3025-3031 (2009).
563. Neretina; Dreaden, E C.; Qian,W. ; Hughes,R.A.; Preston,J.S.; Mascher, P.; El- Sayed, M.A.,The Dependence of the Plasmon Field Induced Nonradiative Electronic Relaxation Mechanisms on the Gold Shell Thickness in Vertically Aligned CdTe−Au Core−Shell Nanorods. Nano Letters, 9(11), 3772–3779 (2009).
564. Huang, X.l Neretina, S.; El-Sayed, M.A., Gold Nanorods: From Synthesis and Properties to Biological and Biomedical Applications. Advanced Materials, 21(48), 4880–4910 (2009).

565. Dreaden, E. C.; Mwakwari, S. C.; Sodji, Q. H.; Oyelere, A. K.; El-Sayed, M. A., Tamoxifen-PEG-Thiol Gold Nanoparticle Conjugates: Enhanced Potency and Selective Delivery for Breast Cancer Treatment. Bioconjugate Chemistry, 20, 2247–2253 (2009).
566. Yen, C. W.; El-Sayed, M. A., Plasmonic Field Effect on the Hexacyanoferrate (III)-Thiosulfate Electron Transfer Catalytic Reaction on Gold Nanoparticles: Electromagnetic or Thermal? Journal of Physical Chemistry C. 113(45), 19585-19590 (2009).
567. Tabor, C.; Van Haute, D.; El-Sayed, M.A., Effect of Orientation on Plasmonic Coupling between Gold Nanorods. ACS Nano, 3(11), 3670-3678 (2009).
568. Mahmoud, M.A.; Snyder, B. J.; El-Sayed, M. A., Polystyrene Microsphere: Inactive Supporting Material for Recycling and Recovering Colloidal Nanocatalysts in Solution. Journal of Physical Chemistry Letters, 1, 28-31 (2010).
569. Chu, L.-K.; El-Sayed, M.A., Bacteriorhodopsin O-state Photocycle Kinetics: A Surfactant Study. Photochemistry and Photobiology, 86, 70 (2010). (Featured by American Society for Photobiology)
570. Chu, L.-K.; El-Sayed, M.A., Kinetics of the M Intermediate in the Photocycle of Bacteriorhodopsin upon Chemical Modification with Surfactants. Photochemistry and Photobiology, 86, 316 (2010).
571. Mahmoud, M.A.; Snyder, B.; El-Sayed, M. A., Surface Plasmon Fields and Coupling in the Hollow Gold Nanoparticles and Surface-Enhanced Raman Spectroscopy. Theory and Experiment. Journal of Physical Chemistry C. 114(16), 7436- 7443 (2010).
572. Kang, B.; Mackey, M.A.; El-Sayed, M.A., Nuclear Targeting of Gold Nanoparticles in Cancer Cells Induces DNA Damage, Causing Cytokinesis Arrest and Apoptosis. Journal of the American Chemical Society, 132(5), 1517–1519 (2010).
573. El-Sayed, M.A.; Yoo, J.W., Preparation of Cubic Pt Nanoparticles deposited on Alumina and their Application to Propene Hydrogenation. Chemcatchem, 2(3),268-271 (2010).
574. Mahmoud M.A.; Poncheri, A.J.; Phillips, R.L.; El-Sayed, M.A., Plasmonic Field Enhancement of the Exciton-Exciton Annihilation Process in a Poly(p-phenyleneethynylene) Fluorescent Polymer by Ag Nanocubes. Journal of the American Chemical Society, 132 (8), 2633-2641 (2010).
575. Yen, C.-W.; Chu, L.-K.; El-Sayed, M.A., Plasmonic Field Enhancement of the Bacteriorhodopsin Photocurrent during its Proton Pump Photocycle. Journal of the American Chemical Society, 132 (21), 7250 – 7251 (2010).
576. Jain, P.K.; El-Sayed, M.A., Plasmonic coupling in noble metal nanostructures. Chemical Physics Letters, 487(4-6), 153-164 (2010).
*** Frontier Article and Journal Cover *** (2nd most downloaded paper of the journal as listed in June 2010)
577. Chu, L.-K.; Yen, C.-W.; El-Sayed, M.A., Bacteriorhodopsin-based Photo- electrochemical cell. Biosensors and Bioelectronics, 26 (2), 620-626 (2010).
578. Chu, L.-K.; Yen, C.-W.; El-Sayed, M.A., On the Mechanism of the Plasmonic Field Enhancement of the Phtocurrent from the Proton Pump Photocycle of Bacteriorhodopsin: Kinetic and Spectroscopic Study. The Journal of Physical Chemistry C 114, 15358-15363 (2010).
579. Huang, X.; El-Sayed, I.H.; El-Sayed, M.A., Fluorescent quenching Gold Nanoparticles: Potential Biomedical Applications. Metal-Enhanced Fluorescence (2010), 573-599. Publisher: John Wiley & Sons, Inc., Hoboken, N. J CODEN: 69NDKJ Conference.
580. Huang, X.H.; Peng, X.H.; Wang, Y.Q.; Wang, Y.X.; Shin, D.M.; El-Sayed, M.A.; Nie, S.M., A Reexamination of Active and Passive Tumor Targeting by Using Rod-Shaped Gold Nanocrystals and Covalently Conjugated Peptide Ligands. ACS Nano, 4(10), 5887- 5896 (2010).

581. Hayden, S.C.; Allam, N.K.; El-Sayed, M.A., TiO2 Nanotube/CdS Hybrid Electrodes: Extraordinary Enhancement in the Inactivation of Escherichia coli. Journal of the American Chemical Society, 132(41), 14406-14408 (2010).
582. Allam, N.K.; Alamgir, F.; El-Sayed, M.A. Enhanced Photoassisted Water Electrolysis using Vertically Oriented Anodically Fabricated Ti-Nb-Zr-O Mixed Oxide Nanotube Arrays. ACS Nano, 4(10), 5819-5826 (2010).
583. Qian, W.; Huang, X.; Kang, B.; El-Sayed, M.A., Dark-fieldLight Scattering Imaging of Living cancer Cell Component from Birth Through Division Using Bioconjugated Gold Nanoprobes. Journal of Biomedical Optics), 15(4), 046025/1-046025/9 (2010).
584. Allam, N.K.; El-sayed, M.A., Photoelectrochemical Water Oxidation Chracteristics of Anodically Fabriated TiO(2) Nanotube Arrays: Structural and Optical Properties. Journal of Physical Chemistry C, 114(27), 12024-12029 (2010).
585. Mahmoud, M.A.; El-Sayed, M.A., Gold Nanoframes: Very High Surface Plasmon Fields and Excellent Near-Infrared Sensors. Journal of the American Chemical Society, 132(36), 12704-12710 (2010).
586. Mahmoud, M. A.; Saira, F.; El-Sayed, M. A., Experimental Evidence for The Nanocage Effect In Catalysis With Hollow Nanoparticles. Nano Letters, 10(9), 3764- 3769 (2010).
587. Chakravarty, P.; Qian, W.; El-Sayed, M.A.; Prausnitz, M.R., Delivery of Molecules into Cells Using Carbon Nanoparticles Activated by Femtosecond Laser Pulses. Nature Nanotechnology, 5(8), 607-611 (2010).
588. Huang, X.H.; Kang, B.; Qian, W.; Mackey, M.A.; Chen, P.C.; Oyelere, A.K.; El- Sayed, H.I.; El-Sayed, M.A., Comparative Study of Photothermolysis of Cancer Cells with Nuclear-targeted or Cytoplasm-targeted Gold Nanospheres: Continuous Wave or Pulsed Lasers. Journal of Biomedial Optics, 15, 058002 (2010).
589. Chu, L.K.; Yen, C.W.; El-Sayed, M.A., On the Mechanism of the Plasmonic Field Enhancement of the Solar-to-electric Energy Conversion by the Other Photosynthetic System in Nature (Bacteriorhodopsin): Kinetic and Spectroscopic Study. Journal of Physical Chemistry C, 114(36), 15358-15363 (2010).
590. Huang, X.; El-Sayed, I.H.; El-Sayed, M.A., Applications of Gold Nanorods for Cancer Imaging and Photothermal Therapy. Methods in Molecular Biology (Totowa, NJ, United States) (2010), 624(Cancer Nanotechnology), 343-357.
591. Allam, N.K.; El-Sayed, M.A., Photoelectrochemical Water Oxidation Characteristics of Anodically Fabricated TiO2 Nanotube Arrays: Structural and Optical Properties. Journal of Physical Chemistry C, 114(27), 12024-12029 (2010).
592. Dreaden,E.C.; Near, R.D.; Abdallah, T.; Talaat, M.H.; El-Sayed, M.A., Multimodal Plasmon Coupling in Low Symmetry Gold Nanoparticle Pairs Detected in Surface- Enhanced Raman Scattering (SERS). Applied Physics Letters (2011). 98, 183115.
593. Dreaden, E.C.; Neretina, S.; Qian, W.; Hughes, R.A.; Preston, J.S.; Mascher, P; El- Sayed, M.A., Plasmonic Enhancement of Nonradiative Charge Carrier Relaxation and Proposed Effects from Enhanced Radiative Electronic Processes in Semiconductor-Gold Core-Shell Nanorod Arrays. Journal of Physical Chemistry C, 2011, 115, 5578–5583.
594. Dreaden, E. C.; Mackey, M.A.; Huang, X.; Kang, B.; El-Sayed, M.A., Beating Cancer to Death in Multiple Ways Using Nanogold. Chemical Society Reviews, 2011, 40 (7), 3391 – 3404.
595. Nishikiori, H.; Uesugi, Y.; Takami, S.; Setiawan, R.; Fujii, T.; Qian, W.; El-Sayed, M.A., Influence of Steam Treatment on Dye-Titania Complex Formation and Photoelectric Conversion Property of Dye-DopedTitania Gel. Journal of Physical Chemistry C, 115(6), 2880-2887 (2011).

596. Mahmoud, M.A.; El-Sayed, M.A., Time Dependence and Signs of the Shift of the Surface Plasmon Resonance Frequency in Nanocages Elucidate the Nanocatalysis Mechanism in Hollow Nanoparticles. Nano Letters, 11(3), 946-953 (2011).
597.Hooshmand, N.; Jain, P.K.; El-Sayed, M.A., Plasmonic Spheroidal Metal Nanoshells Showing Larger Tunability and Stronger Near Fields than their Spherical Counerparts: An Effect of Enhanced Plasmon Coupling. Journal of Physical chemistry letters, 2(5), 374-378 (2011).
598. Hesabi, Z.R.; Allam, N.K.; Dahmen, K.; Garmestani, H.; El-sayed, M.A., Self- Standing Crystalline TiO(2) Nanotubes/CNTs Heterojunction Membrane Synthesis and Characterization. ACS Applied Materials & Interfaces, 3(4) 952-955 (2011).
599.Allam, N.K.; Poncheri, A.J.; El-Sayed, M.A., Vertically Oriented Ti-Pd Mixed Oxynitride Nanotube Arrays for Enhanced Photoelectrochemical Water Splitting. ACS Nano, 5(6), 5056-5066 (2011).
600. Agarwal, A.; Mackey, M.A.; El-Sayed, M.A.; Bellamkonda, R.V., Remote Triggered Release of Doxorubicin in Tumors by Synergistic Application of Thermosensitive Liposomes and Gold Nanorods. ACS Nano, 5(6), 4919-4926 (2011).
601. El-Sayed, M.A., Plasmonic Photochemistry and Photon Confinement to the Nanoscale. Journal of Photochemistry and Photobiology A-Chemistry, 221(2-3), 138-142 (2011).
602. Mahmoud, M.A.; El-Sayed, M.A., Plasmonic Field Effects on the Energy Transger between Poly(p-phenyleneethynylene) Fluorescnet Polymer and Au Nanocages. Journal of Physical Chemistry C, 115(2), 12726-12735 (2011).
603. Hamedani, H. A.; Allam, N.K.; Garmestani, H.; El-Sayed, M.A., Electrochemical Fabrication of Strontium-Doped TiO(2) Nanotube Array Electrodes and Investigation of their Photoelectrochemical Properties. Journal of Physical Chemistry C, 115(27), 13480-13486 (2011).
604. Allam, N.K.; Yen, C.W.; Near, R.D.; El-Sayed, M.A., Bacteriorhodopsin/TiO(2) Nanotube Arrays Hybrid System for Enhanced Photoelectrochemical Water Splitting. Energy & Environmental Science, 4(8), 2909-2914 (2011).
605. Yen, C.W.; Hayden, S.C.; Dreaden, E.C.; Szymanski, P.; El-Sayed, M.A., Tailoring Plasmonic and Electrostatic Field Effects to Maximize Solar Energy Conversion by Bacteriorhodopsin, the Other Natural Photosynthetic System. Nano Letters, 11(9), 3821-3826 (2011).
606. Mahmoud, M.A.; Qian, W.; El-Sayed, M.A., Following Charge Separation on the Nanoscale in Cu(2)O-Au Nanoframe Hallow Nanoparticles. Nano letters, 11(8), 3285- 3289 (2011).
607. Austin, L.A.; Kang, B.; Yen, C.W.; El-Sayed, M.A.,Nuclear Targeted Silver Nanospheres Perturb the Cancer Cell Cycle Differently than Those of Nanogold. Bioconjugate Chemistry, 22(11), 2324-2331 (2011).
608. Austin, L.A.; Kang, B.; Yen C.W.; El-Sayed, M.A., Plasmonic Imaging of Human Oral Cancer Cell Communities during Programeed Cell Death by Nuclear-Targeting Silver Nanoparticles. Journal of the American Chemical Society, 133(44), 17594-17597 (2011).
609. Ali, M. R. K.; Snyder, B.; El-Sayed, M. A., Synthesis and Optical Properties of Small Au Nanorods Using a Seedlesss Growth Thechnique. Langmuir, 28, 9807-9815 (2012).
610.Dreaden, E. C.; Alkilany, A. M., Huang, X. H.; Murphy, C. J.; El-Sayed, M. A., The golden age: gold nanoparticles for biomedicine. Chemical Society Reviews, 41, 2740- 2799 (2012).
611. Dreaden, E. C.; Gryder, B. E.; Austin, L. A.; Defo, B. A. T.; Hayden, S. C.; Pi, M.; Quarles, L. D.; Oyelere, A. K.; El-Sayed, M. A., Antiandrogen Gold Nanoparticles Dual- Target and Overcom Teratement Resistance in Hormone-Insensitive Prostate Cancer Cells. Bioconjugate Chemistry, 23, 1507-1512 (2012).

612. Li, X. X.; Blinn, K.; Fan, Y. C.; Liu M. F.; Mahmoud, M. A.; Cheng, S.; Bottomley, L. A.; El-Sayed, M.; Liu, M. L., Apllication of surface enhanced Raman spectroscopy to the study of SOFC electrode surfaces. Physical Chemicstry Chemical Physics, 14, 5919- 5923 (2012).
613. Lisunova, M.; Mahmoud, M.; Holland, N.; Combs, Z. A.; El-Sayed, M. A.; Tsukruk, V. V., The unusual fluorescenvce intensity enhancement of poly(p-phenyleneethenylene) polymer separated from the silver nanocube surface by H-bonded LbL shells. Journal of Materials Chemistry, 22, 16745-16753 (2012).
614.Mahmoud, M. A.; Chamanzar, M.; Adibi, A.; El-Sayed, M. A., Effect of the Dielectric Constant of the Surrounding Medium and the Substrate on the Surface Plasmon Resonance Spectrum and Sensitivity Factors of Highly Symmetric Systems: Silver Nanocubes. J. Am. Chem. Soc., 134, 6434-6442 (2012).
615. Mahmoud, M. A.; El-Sayed, M. A., Metallic Double Shell Hollow Nanocages: The Challenges of Their Synthetic Techniques. Langmuir, 28, 4051-4059 (2012).
616. Mahmoud, M. A.; Poncheri, A. J.; El-Sayed, M. A.; Properties of pi-Conjugated Fluorescence Polymer-Plasmonic Nanoparticles Hybrid Materials. Journal of Physical Chemistry C, 116, 13336-13342 (2012). [Correction published in 117 (9), 4876-4876 (2013).
617. Near, R.; Tabor, C.; Duan, J. S.; Pachter, R.; El-Sayed, M., Pronounced Effects of anisotropy on Plasmonic Properties of Nanorings Fabricated by Electron Beam Lithography. Nano Lett., 12, 2158-2164 (2012).
618. Nishikiori, H.; Uesugi, Y.; Setiawan, R. A.; Fujii, T.; Qian, W.; El-Sayed, M. A., Photoelectric Conversion Properties of Dye-Sensitized Solar Cells Using Dye-Dispersing Titania. Journal of Physical Chemistry C, 116, 4848-4854 (2012).
619. Szymanski, P.; El-Sayed, M. A.; Some recent developments in photoelectrochemical water splitting using nanostructured TiO2: a short review. Theoretical Chemistry Accounts 131 (2012).
620. Hayden, S. C.; Zhao, G. X.; Saha, K.; Phillips, R. L.; Li, X. N.; Mirands, O. R.; Rotello, V. M.; El-Sayed, M. A.; Schmidt-Krey, I.; Bunz, U. H. F., Aggregation and Interaction of Cationic Nanoparticles on Bacterial Surfaces. J. Am. Chem. Soc., 134, 6920-6923 (2012).
621. Dreaden, E. C.; Austin, L. A.; Mackey, M. A.; El-Sayed, M. A., Size matters: gold nanoparticles in targeted cancer drug delivery. Therapeutic Deleivery, Vol. 3 (4), 457- 478 (2012).
622. Dreaden, E. C.; Mwakwari, S. C.; Austin, L. A.; Kieffer, M. J.; Oyelere, A. K.; El- Sayed, M. A., Small Molecule-Gold Nanorod Conjugates Selectively Target and Induce Macrophage Cytotoxicity towards Breast Cancer Cells. SMALL, 8 (18), 2819-2822 (2012).
623. Kang, B.; Austin, L. A.; El-Sayed, M. A., Real-Time Molecular Imaging throughout the Entire Cell Cycle by Targeted lasmonic-Enhanced Rayleigh/Raman Spectroscopy. Nano Letters, 12 (10), 5369-5375 (2012).
624. Guojun, W.; Mahmoud, M. A.; El-Sayed, M. A., Nanocatalysts Can Change the Number of Electrons Involved in Oxidation-Reduction Reaction with the Nanocages Being the Most Efficient. J. Phys. Chem. C, 116 (45), 24171-24176 (2012).
625. Mohamed, M. B.; Adbel-Ghani, N. T.; El-Borady, O. M.' El-Sayed, M. A., 5- Fluorouracil induces plasmonic coupling in gold nanospheres: new generation of chemotherapeutic agents. Journal of Nanomedicine & Nanotechnology, 3(7), 1000146/1- 1000146/7 (2012).
626. Mahmoud, M. A.; Szymanski, P.; El-Sayed, M. A., Different Methods of Increasing the Mechanical Strength of Gold Nanocages. J. Phys. Chem. Letters, 3(23), 3527-3531 (2012).
627. El-Sayed, M.; Masuhara, H.; Pileni, M-P; Landes, C., Nano and Molecular Science and Technology Special Issue Honoring Paul Barbara. Accounts of Chemical Research, 45(11), 1842-1843 (2012).

628. Near, R.; Hayden, S.; El-Sayed, M., Extinction vs Absorption: Which is the Indicator of Plasmonic Field Strength for Silver Nanocubes?, J. Phys. Chem C, 116(43), 23019- 23026 (2012).
629. Dreaden, E. C.; El-Sayed, M. A., Detecting and Destroying Cancer Cells in More than One Way with Noble Metals and Different Confinement Properties on the Nanoscale. Accounts of Chemical Research, 45(11), 1854-1865 (2012).
630. Mahmoud, M. A.; El-Sayed, M. A. Substrate Effect on the Plasmonic Sensing Ability of Hollow Nanoparticles of Different Shapes. The Journal of Physical Chemistry B 2012, 117 (16), 4468-4477.
631. Hwangl, H. J.; Grifliths, J.; El-Sayed, M. The one dimensional photofragment translational spectroscopic technique: intramolecular clocking of energy redistribution for molecules falling apart1. Time-of-Flight Mass Spectrometry and its Applications 2012, 265.
632. Austin, L. A.; Kang, B.; El-Sayed, M. A., A New Nanotechnology Technique for Determining Drug Efficacy Using Targeted Plasmonically Enhanced Single Cell Imaging Spectroscopy, J Am Chem Soc., (2013).
633. Gupta, M. K.; Konig, T.; Near, R.; Nepal, D.; Drummy, L. F.; Biswas, S.; Maik, S.; Vaia, R. A.; El-Sayed, M. A.; Tsukruk, V. V., Surface Assembly and Plasmonic Properties in Strongly Coupled Segmented Gold Nanorods, Small,
doi: 10.1002/smll.201300248 (2013).
634. Kodiyath, R.; Malak, S. T.; Combs, Z. A.; Koenig, T.; Mahmoud, M. A.; El-Sayed, M. A.; Tsukruk, V. V., Assemblies of silver nanocubes for highly sensitive SERS chemical vapor detection, J. Mater. Chem. A 1(8): 2777-2788 (2013).
635. Mahmoud, M. A.; Narayanan, R.; El-Sayed, M. A., Enhancing Colloidal Metallic Nanocatalysis: Sharp Edges and Corners for Solid Nanoparticles and Cage Effect for Hollow Ones, Acc Chem Res, (2013).
636. Panikkanvalappil, S. R.; Mackey, M. A.; El-Sayed, M. A., Probing the unique dehydration-induced structural modifications in cancer cell DNA using surface enhanced Raman spectroscopy, J Am Chem Soc, (2013).
637. Szymanski, P.; Mahmoud, M. A.; El-Sayed, M. A. The Last Step in Converting the Surface Plasmonic Energy into Heat by Nanocages and Nanocubes on Substrates. Small 2013, 9 (23), 3934-3938.
638. Shaheen, B. S.; Salem, H. G.; El-Sayed, M. A.; Allam, N. K. Thermal/Electrochemical Growth and Characterization of One-Dimensional ZnO/TiO2 Hybrid Nanoelectrodes for Solar Fuel Production. J. Phys. Chem. C 2013, 117 (36), 18502-18509.
639. Setiawan, R. A.; Nishikiori, H.; Uesugi, Y.; Miyashita, K.; El-Sayed, M. A.; Fujii, T. Electron transfer process in fluorescein-dispersing titania gel films observed by time- resolved fluorescence spectroscopy. The Journal of Physical Chemistry C 2013, 117 (20), 10308-10314.
640. Panikkanvalappil, S. R.; Mahmoud, M. A.; Mackey, M. A.; El-Sayed, M. A. Surface-Enhanced Raman Spectroscopy for Real-Time Monitoring of Reactive Oxygen Species-Induced DNA Damage and Its Prevention by Platinum Nanoparticles. ACS Nano 2013, 7 (9), 7524-7533.
641. Near, R. D.; Hayden, S. C.; Hunter, R. E.; Thackston, D.; El-Sayed, M. A. Rapid and Efficient Prediction of Optical Extinction Coefficients for Gold Nanospheres and Gold Nanorods. J. Phys. Chem. C 2013, 117 (45), 23950-23955.
642. Near, R. D.; Hayden, S. C.; El-Sayed, M. A. Thin to Thick, Short to Long: Spectral Properties of Gold Nanorods by Theoretical Modeling. J. Phys. Chem. C 2013, 117 (36), 18653-18656.
643. Near, R. D.; El-Sayed, M. A. Hollow gold nanorectangles: The roles of polarization and substrate. J. Chem. Phys. 2013, 139 (4).

644. Nashed, R.; Alamgir, F. M.; Seung-Soon, J.; Ismail, Y.; El-Sayed, M. A.; Allam, N. In Towards a perfect system for solar hydrogen production: an example of synergy on the atomic scale, SPIE Solar Energy+ Technology, International Society for Optics and Photonics: 2013; pp 88220A-88220A-7.
645. Nashed, R.; Alamgir, F. M.; Jang, S. S.; Ismail, Y.; El-Sayed, M. A.; Allam, N. K. Bandgap bowing in Ta-W-O system for efficient solar energy conversion: Insights from density functional theory and X-ray diffraction. Appl. Phys. Lett. 2013, 103 (13).
646. Mahmoud, M. A.; O'Neil, D.; El-Sayed, M. A. Hollow and Solid Metallic Nanoparticles in Sensing and in Nanocatalysis. Chem Mater 2013, 26 (1), 44-58.
647. Mahmoud, M. A.; Garlyyev, B.; El-Sayed, M. A. Determining the Mechanism of Solution Metallic Nanocatalysis with Solid and Hollow Nanoparticles: Homogeneous or Heterogeneous. J. Phys. Chem. C 2013, 117 (42), 21886-21893.
648. Mahmoud, M. A.; El-Sayed, M. A.; Gao, J. P.; Landman, U. High-Frequency Mechanical Stirring Initiates Anisotropic Growth of Seeds Requisite for Synthesis of Asymmetric Metallic Nanoparticles like Silver Nanorods. Nano Lett. 2013, 13 (10), 4739- 4745.
649. Mahmoud, M. A.; El-Sayed, M. A. Substrate Effect on the Plasmonic Sensing Ability of Hollow Nanoparticles of Different Shapes. J. Phys. Chem. B 2013, 117 (16), 4468- 4477.
650. Mahmoud, M. A.; El-Sayed, M. A. Different Plasmon Sensing Behavior of Silver and Gold Nanorods. Journal of Physical Chemistry Letters 2013, 4 (9), 1541-1545.
651. Mackey, M. A.; Saira, F.; Mahmoud, M. A.; El-Sayed, M. A. Inducing Cancer Cell Death by Targeting Its Nucleus: Solid Gold Nanospheres versus Hollow Gold Nanocages. Bioconjugate Chem 2013, 24 (6), 897-906.
652. Lee, J.-P.; Chen, D.; Li, X.; Yoo, S.; Bottomley, L. A.; El-Sayed, M. A.; Park, S.; Liu, M. Well-organized raspberry-like Ag@ Cu bimetal nanoparticles for highly reliable and reproducible surface-enhanced Raman scattering. Nanoscale 2013, 5 (23), 11620- 11624.
653. Kang, B.; Afifi, M. M.; Austin, L. A.; El-Sayed, M. A. Exploiting the Nanoparticle Plasmon Effect: Observing Drug Delivery Dynamics in Single Cells via Raman/Fluorescence Imaging Spectroscopy. ACS Nano 2013, 7 (8), 7420-7427.
654. Hayden, S. C.; Austin, L. A.; Near, R. D.; Ozturk, R.; El-Sayed, M. A. Plasmonic enhancement of photodynamic cancer therapy. Journal of Photochemistry and Photobiology a-Chemistry 2013, 269, 34-41.
655. El-Sayed, M. A.; Shabaka, A. A.; El-Shabrawy, O. A.; Yassin, N. A.; Mahmoud, S. S.; El-Shenawy, S. M.; Al-Ashqar, E.; Eisa, W. H.; Farag, N. M.; El-Shaer, M. A.; Salah, N.; Al-Abd, A. M. Tissue Distribution and Efficacy of Gold Nanorods Coupled with Laser Induced Photoplasmonic Therapy in Ehrlich Carcinoma Solid Tumor Model. Plos One 2013, 8 (10).
656. Combs, Z. A.; Malak, S. T.; König, T.; Mahmoud, M. A.; Chávez, J. L.; El-Sayed, M. A.; Kelley-Loughnane, N.; Tsukruk, V. V. Aptamer-Assisted Assembly of Gold Nanoframe Dimers. Particle & Particle Systems Characterization 2013, 30 (12), 1071- 1078.
657. Nashed, R.; Szymanski, P.; El-Sayed, M. A.; Allam, N. K. Self-Assembled Nanostructured Photoanodes with Staggered Bandgap for Efficient Solar Energy Conversion. ACS Nano 2014, 8 (5), 4915-4923.
658. Malak, S. T.; König, T.; Near, R.; Combs, Z. A.; El-Sayed, M. A.; Tsukruk, V. V. Stacked Gold Nanorectangles with Higher Order Plasmonic Modes and Top-Down Plasmonic Coupling. The Journal of Physical Chemistry C 2014, 118 (10), 5453-5462.
659. Mahmoud, M. A.; O'Neil, D.; El-Sayed, M. A. Shape- and Symmetry-Dependent Mechanical Properties of Metallic Gold and Silver on the Nanoscale. Nano Lett. 2014, 14 (2), 743-748.

660. Mackey, M. A.; El-Sayed, M. A. Chemosensitization of Cancer Cells via Gold Nanoparticle-Induced Cell Cycle Regulation. Photochem Photobiol 2014, 90 (2), 306- 312.
661. Mackey, M. A.; Ali, M. R. K.; Austin, L. A.; Near, R. D.; El-Sayed, M. A. The Most Effective Gold Nanorod Size for Plasmonic Photothermal Therapy: Theory and In Vitro Experiments. J. Phys. Chem. B 2014, 118 (5), 1319-1326.
662. Li, X.; Lee, J.-P.; Blinn, K. S.; Chen, D.; Yoo, S.; Kang, B.; Bottomley, L. A.; El- Sayed, M. A.; Park, S.; Liu, M. High-temperature surface enhanced Raman spectroscopy for in situ study of solid oxide fuel cell materials. Energy & Environmental Science 2014, 7 (1), 306-310.
663. König, T. A.; Ledin, P. A.; Kerszulis, J.; Mahmoud, M. A.; El-Sayed, M. A.; Reynolds, J. R.; Tsukruk, V. V. Electrically Tunable Plasmonic Behavior of Nanocube- Polymer Nanomaterials Induced by a Redox Active Electrochromic Polymer. ACS Nano, 2014, 8 (6), 6182-6192.
664. König, T.; Kodiyath, R.; Combs, Z. A.; Mahmoud, M.; El-Sayed, M. A.; Tsukruk, V. V. Silver Nanocube Aggregates in Cylindrical Pores for Higher Refractive Index Plasmonic Sensing. Particle & Particle Systems Characterization 2014, 31 (2), 274-283.
665. Kang, B.; Austin, L. A.; El-Sayed, M. A. Observing Real-Time Molecular Event Dynamics of Apoptosis in Living Cancer Cells using Nuclear-Targeted Plasmonically Enhanced Raman Nanoprobes. ACS Nano 2014, 8 (5), 4883-4892.
666. Hooshmand, N.; O'Neil, D.; Asiri, A. M.; El-Sayed, M. A. The Spectroscopy of Homo and Heterodimers of Silver and Gold Nanocubes as a Function of Separation: a DDA Simulation. The Journal of Physical Chemistry A, Article ASAP.
667. Hooshmand, N.; El-Sayed, M. A.; Bordley, J. A. Are Hot Spots between Two Plasmonic Nanocubes of Silver or Gold Formed between Adjacent Corners or Facets? A DDA Examination. The Journal of Physical Chemistry Letters 2014, 5 (13), 2229-2234.
668. Dreaden, E. C.; Raji, I. O.; Austin, L. A.; Fathi, S.; Mwakwari, S. C.; Humphries, W. H.; Kang, B.; Oyelere, A. K.; El-Sayed, M. A. P-Glycoprotein-Dependent Trafficking of Nanoparticle-Drug Conjugates. Small 2014, 10 (9), 1719-1723.
669. Austin, L. A.; Mackey, M. A.; Dreaden, E. C.; El-Sayed, M. A.The optical, photothermal, and facile surface chemical properties of gold and silver nanoparticles in biodiagnostics, therapy, and drug delivery. Arch. Toxicol. 2014, 1-27.
670. Ali, M. R.; Panikkanvalappil, S. R.; El-Sayed, M. A. Enhancing the Efficiency of Gold Nanoparticles Treatment of Cancer by Increasing Their Rate of Endocytosis and Cell Accumulation Using Rifampicin. J Am Chem Soc 2014, 136 (12), 4464-4467.
671. Ahmed, S. M.; Szymanski, P.; El-Nadi, L. M.; El-Sayed, M. A. Energy-Transfer Efficiency in Eu-Doped ZnO Thin Films: The Effects of Oxidative Annealing on the Dynamics and the Intermediate Defect States.ACS Applied Materials & Interfaces 2014, 6 (3), 1765-1772.
672. Afifi, M. M.; Austin, L. A.; Mackey, M. A.; El-Sayed, M. A. XAV939: From a Small Inhibitor to a Potent Drug Bioconjugate When Delivered by Gold Nanoparticles.Bioconjugate Chem 2014, 25 (2), 207-215.
673. Kang, X.; Zhang, J.; Rohas, A. J.; O'Neil, D.; Szymanski, P.; Marder, S. R.; El- Sayed, M. A. Deposition of Lossely Bound Organic D-a-[Small Pi]-a[Prime or Minute] Dyes on Sensitized TiO2 Film: A Possible Strategy to Suppress Charge Recombination and Enhance Power Conversion Efficientcy in Dye-Sensitized Solar Cells. J. Mat. Chem. A2014, 2, 11229-11234.

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