Софийски университет „Св. Климент Охридски“
Физически факултет

ФАКУЛТЕТЕН СЕМИНАР

сряда, 26 юни 2013 г., 16:15 часа, зала А315

Prof. Paras N. Prasad

State University of New York at Buffalo, USA

Chiral and Metaphotonics: Emerging New Frontiers in Photonics

Chiral photonics is an emerging multidisciplinary field that explores chiral control by using the differences between the linear and nonlinear optical functions for the left and right circularly polarized light, for applications ranging from optical switching, to negative- and near-zero refractive index metamaterials, to chiral bioimaging. Realization of such applications requires materials with optical chirality at visible wavelengths that is orders of magnitude larger than that of any naturally-occurring materials. This talk will describe our efforts involving theoretical modeling, design, synthesis and supramolecular organization of chiral polymers. We have shown nanoscale control of interactions to dramatically enhance optical chirality, thus yielding unprecedented values for both linear and nonlinear chiral optical responses.

Metaphotonics is a new field that deals with manipulation of electric and magnetic fields and their coupling in nanoengineered materials to control the field distribution and propagation of electromagnetic waves. The application of metaphotonics ranges from photonics communications, to solar energy harvesting, to sensor technology, to biophotonics. Metaphotonics covers a broad scope which includes:

1) Chiro-Optics effect, the basis for chiral photonics that also describes coupling of electrical and magnetic dipoles in a chiral medium for manipulation of beam propagation. It provides a new chemical approach to achieve negative refraction. Our theory guided design of novel polymeric chiral nanocomposites to yield negative refractive index will be discussed, along with our more recent report of plasmonic and excitonic enhancement of Chirality.

2) Magnetic-Optics that deals with magnetic control of optical fields and involves cross coupling between electric and magnetic fields. The two principal effects are magneto optical rotation, also known as Faraday rotation, and magnetic circular dichroism. Our efforts in this direction, using nanocomposites of chiral polymer and magnetic nanoparticles will be presented. A promising direction is the use of stable organic biradicals.

3) Magneto-Plasmonics describes coupling between magnetic field and plasmonic field which can be used for sensing as well as for dual modality bioimaging and photothermal therapy. We are modeling and develoing two such systems in a core –shell geometry: one is iron oxide core with gold shells and the other is iron – platinum core with gold shell.

4) Plexitonics involves Plasmon-exciton coupling to manipulate the plasmonic field distribution, absorption and scattering. It can be useful for enhancement in solar cell efficiency. We are studying doped Copper Chalcogenide system with an additional plasmonic domain.

5) Spin-Photonics describes Optical control of magnetization. Here our efforts are both on inorganic and organic nanostructures with a rich manifold of excited spin states as well as their nanocomposites.

6) Switchable/Transformable Materials in which electric, optical and magnetic fields can be used for dynamic and reversible control of optical field as well as of their linear and nonlinear optical functions. Here our efforts in electrically and optically switchable liquid crystal based photonic structures will be presented.

This talk will conclude with a discussion of new opportunities in these fields.

1) P. N. Prasad "*Nanophotonics*" John Wiley & Sons, (2004)
2) P. N. Prasad "*Introduction to Biophotonics*" John Wiley & Sons, (2003)
3) P. N. Prasad "*Introduction to Nanomedicine and Nanobioengineering*" John Wiley & Sons, (2012)

PARAS N PRASAD, Ph.D. is the SUNY Distinguished Professor of Chemistry, Physics, Electrical Engineering and Medicine; the Samuel P. Capen Chair of Chemistry; and the Executive Director of the Institute for Lasers, Photonics and Biophotonics at the University at Buffalo. He was named among the top 50 science and technology leaders in the world by Scientific American in 2005. He has published 700 scientific and technical papers in high-impact journals; four monographs that practically defined the fields of organic nonlinear optics, Biophotonics, Nanophotonics, Nanobioengineering and Nanomedicine; eight edited books; and holds numerous patents. He is the recipient of many scientific awards and honors (Morley Medal; Schoellkopf Medal; Guggenheim Fellowship, Sloan Fellowship; Western New York Health Care Industries Technology/Discovery Award; Fellow of the APS, OSA, and SPIE). He is a pioneer in nanophotonics, biophotonics and nanomedicine, and has been giving plenary, opening and keynote lectures worldwide in these fields.