

2. Plasmonics and nanophotonics

By

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Host: Assoc Prof. Cesare Soci

Abstract

Plasmonics and nanophotonics belong to the field of laser interaction with nanostructures. In this lecture we will discuss the creation of strong local fields, both electrical and magnetic, near nanoscale metal and dielectric structures. Selecting the parameters of nanostructures can control various characteristics of local fields. As an example, various effects due to the scattering of laser radiation by a sphere (the Mie theory) are considered. The field lines of Poynting vector around a small particle are investigated based on the classical Mie theory. A particle can effectively absorb incident energy near the optical resonance, where its optical absorption cross-section becomes much greater than its geometrical cross-section. It is shown that absorbed energy flows into the particle through some limited portion of its surface (“input window”) instead of the whole surface as it follows from the dipole approximation. This “input window” expands with the increasing value of the imaginary part ϵ'' of the dielectric function of the particle. For a small ϵ'' the absorbed energy is released by the plasmon radiation. Interference of this radiation with the incident wave creates complex patterns of energy flux in the near-field region. These patterns cannot be understood within the frame of a dipole approximation and the terms of higher orders with respect to size parameter are necessary. It is possible to generate nano vortices near plasmonic and dielectric nanoparticles. Thus, we are discussing the different applications of such nano vortices.

Short Biography

Boris Lukiyanchuk received his PhD (Physics and Mathematics) from P. N. Lebedev Physical Institute, Academy of Sciences of USSR in 1979 and his Doctor of Sciences from the General Physics Institute, Academy of Sciences of USSR in 1991. From 1970 to 1980, he was affiliated to the Scientific Research Institute at Moscow, Russia. He was also a Professor, Scientific Advisor and Principal Scientist at Data Storage Institute, A*STAR, Singapore from 1999-2018. Currently he is the Professor, Head of the Nonlinear and Extreme Nanophotonics Laboratory, Lomonosov Moscow State University and Visiting Professor at SPMS, NTU. His research interests include interaction of laser radiation with matter, chemical processing with lasers, nonlinear phenomena, self-organization, laser-ablation, theory of nanocluster formation, photomodification in polymers, laser cleaning, plasmonics, metamaterials, nanoscopy, Nanophotonics and nanoparticles with high refracted index. He is a Honorary Professor at Johannes Kepler University, Austria, a recipient of the IES Prestigious Engineering Achievement Awards (2004), President's Science Award, Singapore (2013). He is a member of the Scientific Counsels of Russian Academy of Sciences, SPIE (2000) and OSA (2010). He has supervised >30 PhD students. He has authored 5 monographs and over 300 original research papers till date.