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Efficient simulations and statistical analysis of physical characteristics of dispersive ensembles of semiconductor nano-objects

Oleksandr Voskoboynikov
National Chiao Tung University, Taiwan

Impressive development of modern semiconductor nano-technologies makes it possible to fabricate semiconductor nano-objects (quantum dots, quantum rings, quantum dot molecules, quantum dot posts, nano-rods, etc.) with very sophisticated shapes and material compositions. Incorporating controllable and tunable nano-objects into nano-structured systems and meta-materials leads to tunable (on the quantum level) properties of the systems. It is well known, that in nano-optics, nano-medicine, and for quantum information processing, we need systems assembled from many all uniform and regular nano-sized elements. Unfortunately, the inherent dispersion of parameters (shape, size and material composition) leads to fluctuations (sometimes uncontrollable) of the physical characteristics of macro-systems combined from the nano-objects. In this talk, we present and discuss a general theoretical description of the physical characteristics of dispersive ensembles of semiconductor nano-objects with complex geometries and material compositions. The description is based on the mapping and hybrid multiscale (hierarchical) methods (recently derived by us) and the multi-parametric (multivariate) statistical analysis, which cumulatively reproduces the physical characteristics of ensembles of semiconductor nano-objects with dispersion in geometry, material parameters, and spatial distributions. We demonstrate the description efficiency by applying our approach to obtain the magnetic and magneto-optical responses of dispersive ensembles of semiconductor self-assembled quantum rings and the absorption cross section of ensembles of core/shell quantum dots. We have effectively simulated the actual magnetic and magneto-optical characteristics in a very good agreement with recent experimental data. Our approach can be used for optimization of the averaged physical characteristics of dispersive ensembles of semiconductor nano-objects.

Biography

Oleksandr Voskoboynikov received his doctor degree in Semiconductor Theory from the National Taras Shevchenko University of Kyiv, Ukraine in 1983. In 1997, he was awarded with the State Prize of Ukraine for Science and Technology. He is currently with the National Chiao Tung University, Hsinchu, Taiwan. His current research interests include theory of electronic and optical quantum processes in semiconductor nano-structures: Self-consistent calculation of the response functions of semiconductor nano-structures; magneto-optics of semiconductor nano-objects and metamaterials made from them. He has published more than 150 papers in refereed journals, two books, and few book chapters.

vam@faculty.nctu.edu.tw

A study of the optical properties of un-doped, potash and bamboo doped lead chloride ($PbCl_2$) crystals in silica gel

Don U.V. Okpala, Don C.I. Elekalachi and Don R.E. Enemor
Anambra State University, Nigeria

The optical properties of un-doped, potash and bamboo doped lead chloride crystal ($PbCl_2$) have been studied by sol gel technique. The optical properties of the materials were determined using a JENWAY 6405 UV-Vis spectrophotometer operating at a wavelength range of 200 nm to 1200 nm at an interval of 5 nm. It was observed that the crystals are optically transparent. The average refracting index (n) ranged from 0.5 to 2.7. The band gap is from 2.8 to 3.6, showing that they are wide band gap materials and are good refractory materials for solid state, electronic and solar energy applications.

Biography

Don U.V. Okpala is a Ph.D. holder in Solar Energy Physics. He is the Coordinator of Emeagwali Centre for Research Renewable Energy and Materials Science, Anambra State University, Uli, Anambra State. He has up to fifteen papers. He is interested in solar energy physics, solid state physics and materials science.

ifarauc@yahoo.com