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Band structure of a 2D photonic crystal based on ferrofluids of $Co_{(1-x)}Zn_xFe_2O_4$ nanoparticles under perpendicular applied magnetic field

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Using a ferrofluid of cobalt-zinc ferrite nanoparticles (Co0.8Zn0.2Fe2O4) coated with oleic acid and suspended in ethanol, we have fabricated a 2D photonic crystal (PC) by the application of an external magnetic field perpendicular to the plane of the ferrofluid. The 2D PC is made by rods of nanoparticles organized in a hexagonal structure. By means of the plane-wave expansion method, we studied its photonic band structure (PBS) which depends on the effective permittivity and on the area ratio of the liquid phase. Additionally, taking into account the Maxwell-Garnett theory, we calculated the effective permittivity of the rods. We have found that the effective refractive index of the ferrofluid increases with its magnetization. Using these results, we calculated the band structure of the photonic crystal at different applied magnetic fields, finding that the increase of the applied magnetic field shifts the band structure to lower frequencies with the appearance of more band gaps.

Biography

Javier Lopez has completed his undergraduate and the M.S. in Physics at the age of 30 years in the Universidad del Valle-Colombia. Most of his career has been devoted to the research and development of the materials science. Currently, he is developing his doctoral research work in the nanomagnetism area, applied to the study of magnetic nanoparticles for applications in nanophotonics and optoelectronic devices. He joined the Thin Films Group in 2003 and the Excellent Center for New Materials in 2005. He has published several papers into internationals recognized journals. At present, the research lines of interest are: Nanomagnetism, nanoparticles, ferrofluids and photonic crystals.

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Synthesis and characterization of CeO_2 nanocrystals with various controlled morphologies and their effect towards exclusively selective catalytic oxidation reaction

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As one of the most reactive and abundant among the rare earth elements, occupying about 0.0046 wt% of the earth's crust, cerium oxide (CeO_2) has attracted intense interest because of its environmental and energy related applications as catalysts. Moreover, CeO_2 particles having well defined morphology are coveted in a variety of applications, mainly as catalyst in various industrially important oxidation reactions nowadays. The remarkable improvement in catalytic, mechanical and redox properties have been come from the controlled size and shapes of CeO_2 nanoparticles, which is mainly responsible to expose their specific active crystal facets, which is again thus a key factor to their ultimate performance. We have performed various controlled synthesis for developing novel morphologies of CeO_2 nanocrystals with well-defined shapes and size by using a simple surfactant assisted solvothermal and high temperature colloidal technique. It is noteworthy to mention here that we were able to controllably synthesize polyhedron shaped nanorods and most interestingly highly energetic crystal planes (100) terminated self-aggregated CeO_2 nanocubes. All these interesting shapes of CeO_2 nanocrystals were well-characterized by XRD, UV-VIS spectroscopy, HRTEM and FESEM from which we concluded our derived structure. Further we applied all these morphologies of CeO_2 nanocrystals as heterogeneous catalyst for exclusively selective oxidation of industrially important para-xylene to terephthalic acid reaction in environmentally friendly condition for the first time, where water was used as solvent. Our observation revealed how these various shapes of CeO_2 nanocrystals effect on the formation of desired catalytic oxidation product.

Biography

Kalyanjyoti Deori is a doctoral fellow at Department of chemistry, University of Delhi, India. He has received his master's degree in Chemistry from the same university in 2009 and then joined to Dr. Sasanka Deka's Research group as a Ph.D. student. He was awarded Junior Research Fellowship in 2010 and Senior Research Fellowship in 2013 by CSIR-UGC, India, for doing Ph.D. He has published one paper and one US patent is under process. Recently, he has received the best poster award in DAE-BRNS 4th Interdisciplinary Symposium on Materials Chemistry, (ISMC-2012), BARC, Mumbai. His main research activities are focused on development of metal oxide based hybrid nanocrystals for various catalysts and as energy material.

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