(1) Title of the paper

Anisotropic light absorption and emission in structured nanoparticles

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Abstract

For semiconductor particles dispersed in a medium with lower refractive index, the dielectric contrast strongly affects absorption and emission. Core/shell quantum structures can provide efficient photoluminescence and, especially in the case of Cd-based materials, they can be synthesized with complex morphologies, one example being the dot-in-rod. In this work we show that the absorption of a homogeneous nanoparticle depends on the shape of the particle and the polarization of the illumination. The direction and polarization of the photon emission from a core/shell nanoparticle depends on the shape of the particle and the position of the quantum dot. The anisotropy in absorption and emission can be very different and even have opposite sign.

In this work we present calculations of absorption and emission by dot-in-rod particles with different shapes and different contrast in refractive index. These calculations are based on finite-element quasi-static field calculations and full electromagnetic field calculations. For anisotropic particles, the absorption typically depends on the polarization of the incident light. The emission by the quantum dot is modified by the shape of the surrounding shell and this leads to variations in the intensity and in the degree of polarization on the emission direction.

Each application of photoluminescence has its own requirement and often the directivity and polarization of both absorption and emission are relevant. The analysis of absorption and emission that is carried out in this work allows to suggest novel structures of photoluminescent particles and to define their optimal orientation in a structure. This work may lead to efficiency gains in a range of optoelectronics applications.