

ABSORPTION OF LIGHT BY NANOMATERIALS (THE CASE OF SILICON): DO WE LOSE OR GAIN BY DISPERSING BULK MATERIAL INTO NANOPARTICLES?

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Abstract

Absorption cross section (ACS) is a basic parameter of any absorbing material including semiconductor quantum dots / nanocrystals (NCs). It has a crucial importance for considering applications like solar cells or optically excited bio-labels. In our contribution we compare two experimental methods to determine ACS via (i) absorption spectra and morphology information (density of nanocrystals from TEM or dark-field scattering analysis) and (ii) luminescence spectroscopy under modulated excitation. The weak points of both approaches and experimental details are discussed. Our experimental results are compared to available literature data, including theoretical calculations. The results show that we can actually gain (about twice) absorption per Si volume by forming nanocrystals but the absorption per total nanocomposite (Si and oxide matrix) volume is lower than for bulk Si. Therefore, some tricks to increase ACS of Si NCs (e.g. using plasmonics) are needed.

Keywords: Nanocrystals, silicon, absorption, luminescence

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