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Self-ordered Ge-based core/shell quantum dots in glass matrix

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Simple fabrication processes of Ge-based nanostructures in glasses are very interesting due to the highly tuneable electronic structure and many relevant applications. We address the recent advances in the production of regularly ordered Ge/Si and Ge/metal core/shell nanostructures formed by magnetron sputtering deposition in glass alumina matrix [1]. The regular ordering of these nanostructures is achieved by the self-ordering growth regime that occurs under specific deposition conditions [2]. We have developed the theory and software for the analysis of such materials by small grazing incidence angle x ray scattering (GISAXS) [3].

The light absorption properties of these films are significantly different compared to films that form quantum dot lattices of the pure Ge, Si, metal or a solid solution of the constituents. The Ge/Si core/shell quantum dots show a strong narrow absorption peak that characterizes a type II confinement in accordance with the theoretical predictions. In addition, we show that the peak position and width depend strongly on the size of Ge core and Si shell [4]. These materials are very interesting for the application in quantum dot solar cells.

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Figure 1. GISAXS maps of Ge/Si quantum dots in amorphous alumina matrix differing by the size of Ge-core and Si-shell.