

Growth and Spectroscopy of Semiconductor Quantum Dots

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The talk will be addressed to general public, including high school students. Semiconductor quantum dots attract a growing attention, as they can be applied in emerging new fields related to information technologies: quantum cryptography and quantum computing. A single semiconductor quantum dot approaches the ultimate limit of information storage density.

After a short motivation part, growth of semiconductor quantum dots by molecular beam epitaxy (MBE) will be described, in particular, spontaneous formation of self-assembled quantum dot systems. Basic characterization methods will be presented, including in-situ electron diffraction, atomic force microscopy, and high resolution electron transmission microscopy.

Then optical experiments will be discussed: how we select a single quantum dot from a dense ensemble, and use light to write information in the dot. Various experimental techniques will be described: from simple microphotoluminescence measurements to various time- and polarization-resolved experiments, including correlated photon counting. The experiments involve magnetic fields and low temperatures, as well as tunable laser providing ultra-short femtosecond light pulses. These advanced experimental tools allow us to study the evolution of the information recorded in a quantum dot, under influence of various perturbations, including in-plane anisotropy of quantum dots, electric and magnetic fields, etc. Finally, read-out of the information from the quantum dot will be described.