CdSe Quantum Dots in ZnSe/(Zn,Mg)Se core/shell nanowires

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Nanowires (NWs) are considered as interesting structures for novel electronic and opto-electronic devices functionalities. The growth of nanowires enable the fabrications of well controlled 1D nanoscale heterostructures changing the composition of source materials along the longitudinal or radial direction. Single CdSe quantum dot insertion in the NW seems to be an excellent candidate for stable and efficient single photon source at high temperatures [1].

In this work we present the fabrication and studies of ZnSe nanowires with CdSe quantum dots, all covered by a thin layer of (Zn,Mg)Se. It's presence on the whole surface of the nanowire increases the luminescence ratio due to passivation of the nonradiative, surface recombination of photons generated in CdSe dot [2,3]. We report on preliminary results on growth, structural, chemical and optical properties of these nanostructures.

The growth process is performed on GaAs substrate by molecular beam epitaxy (MBE), using vapor-liquid-solid method with gold as the catalyst. The source materials for the MBE system are elemental Zn, Cd, Mg,Se. The growth parameters are determined by temperature of the substrate, the value of the beam equivalent pressure of molecular fluxes and the time of growth. The procedure is monitored by RHEED observation. The results of as grown nanowires were examined by field emission of scanning electron microscope (FESEM). The obtained images give information on NWs dimensions, crystallographic orientation and general quality of growth. We will present the crystallographic structure studies by aberration corrected high resolution transmission electron microscope (Cs-HRTEM) performed using a Titan Cube 80-300 working at 300 kV.

For spectroscopic studies, the nanowires are removed from the substrate and placed flat on a silicon layer. At liquid helium temperatures, we observe narrow (0.5 meV) emission lines in the luminescence spectra. According to observed PL energy (about 2.5 eV), the lines are attributed to the quantum dots insertions. The emission lines are linearly polarized, with the contrast up to 85 %, and polarization direction, considered to indicate the axis of nanowire [1,4], is the same as the preferred polarization direction for excitation.

We will present the preliminary magneto-optical studies of the system. We follow the luminescence spectra of the single emitter in magnetic field up to 10 T. The magnetic field is applied in both Voigt and Faraday configuration. In the measurements in Voigt configuration, we control the angle between magnetic field and the axis of the nanowire. This is possible by using the information about nanowire alignment obtained from the studies of polarization of emission.

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