Raman scattering studies of MBE-grown ZnTe, $Zn_{1-x}Mg_xTe$ and $Zn_{1-x}Mn_xTe$ nanowires

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We report on the first studies of the optical properties of MBE-grown ZnTe-based nanowires (NWs). The growth of ZnTe, $Zn_{0.8}Mg_{0.2}Te$, and $Zn_{0.9}Mn_{0.1}Te$ NWs was based on the Au-catalyzed vapour-liquid-solid mechanism and was performed on (001), (011), or (111)-oriented GaAs substrates. Investigated NWs have a zinc-blende structure, an average diameter of about 30 nm, and typical length between 1 and 2 μm. Their growth axes are oriented along <111>-type directions of the substrate.

The macro-Raman spectra of either as-grown NWs on GaAs substrate or of NWs removed from substrate and deposited onto Si were collected at temperatures from 15 K to 295 K using Ar^+ and Kr^+ laser lines for the excitation. Strong enhancement of ZnTe-related LO-phonon structure was found for an excitation close to the exciton energy. Micro-Raman studies performed at room temperature made it possible to investigate optical properties of single NWs. Under resonant conditions we observed a set of LO-phonon replica. Our studies reviled the presence of small, hexagonal Te precipitates, typical for tellurium compounds (and present even for MBE-grown layers and structures). Raman data are completed by the results of photoluminescence measurements and correlated with NWs growth parameters. The influence of defects on optical spectra is shown and discussed.

Reported research is important in view of possible applications of NWs as very versatile building blocks for future nanoelectronics. NWs based on ZnTe can play particularly important role in the bottom-up approach to spin-operating (spintronic) nanodevices due to the ease of both Mn incorporation and p-type nitrogen doping of this semiconductor.

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