Determination by magneto-photoluminescence of exciton reduced mass and gyromagnetic factor of wurtzite InGaAs nanowires

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Semiconductor nanowires (NWs) have enormous potential as building blocks for nanoscale devices. However, the impact of their one-dimensional geometry and peculiar crystal phase on transport and spin characteristics remains largely unknown. Here, we address these issues on wurtzite (WZ) InGaAs NWs by photoluminescence (PL) measurements under intense magnetic fields (B= 0-28 T) [1]. At zero field, the luminescence of NW *ensembles* exhibits a linear polarization degree as high as 90% and directed orthogonal to the NW axis, that is a distinctive feature of the wurtzite phase. Exciton diamagnetism, Zeeman splitting, and circular dichroism were measured in ensembles of more than 10^5 wires for different relative orientations between the magnetic field and the WZ $\hat{c}$ axis. We found: *i*) An increase in the exciton reduced mass of the WZ phase with respect to that of the zincblende phase. *ii*) A marked anisotropy in the exciton reduced mass, which is 25% heavier in the *c*-plane than in the *a*-plane of the NW WZ lattice; see Figure 1(a). *iii*) A field-dependent exciton gyromagnetic factor equal to -3 for B>12 T; see Figure 1(b). *iv*) A field-induced circular dichroism of the emitted light in excess of 70% at the highest field employed. Thus, our results provide evidence of anisotropies in transport properties of NWs, an assessment of NW spin characteristics, and can act as a valuable benchmark for band structure calculations aimed at exploiting the unique properties of NWs.

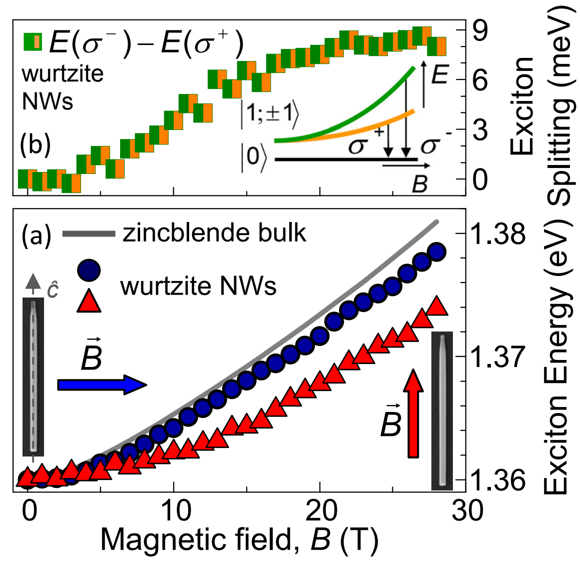

Figure 1: (a) Exciton energy of bulk (InGa)As and WZ (InGa)As NWs with B // and ⊥ to $\hat{c}$. (b) Exciton splitting of WZ (InGa)As NWs.

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