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Theory of photoluminescence polarization reversal in GaAs nanowires W.R.L. LAMBRECHT, T. CHEIWCHANCHAMNANGIJ, T. BIRKEL, CWRU, AL. L. EFROS, NRL — The polarization of photoluminescence (PL) in wurtzite (WZ) GaAs nanowires (NW) of diameter 100 nm has been observed to reverse as a function of temperature from perpendicular to parallel to the NW axis. We use the weak confinement limit for excitons and the envelope function approximation to study this phenomenon. The WZ GaAs crystal field and spin-orbit splittings were determined using GW calculations and agree well with resonant Raman spectra on WZ NWs. In contrast to zincblende (ZB) NWs, the crystal field splitting in WZ NWs leads to a perpendicularly polarized exciton ground state. The first excited state, however, has a parallel component and can be mixed in at slightly elevated temperature, leading to a polarization reversal. We find that a reversal can only take place for much smaller crystal field splittings than the one obtained in pure WZ. Strain induced reduction of the crystal field splitting would require an unrealistically large strain. On the other hand, multiple twinning, can lead to a substantially lower crystal field splitting as obtained from our GW calculations for lower hexagonality polytypes, such as 4H GaAs, and can thus explain the observed polarization reversals.

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