Electric Field-Induced Emission Enhancement and Modulation in CdSe Nanowires

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Semiconductor nanowires, having advantages of tunable electronic structures using quantum confinement effects, are a class of materials with many powerful properties for future technologies. Their advantages are high photoluminescence efficiency, strongly linear polarized emission significantly faster carrier relaxation.

In this work the model for explanation of phenomenon where the emission intensity NWs is enhanced and modulated by external electric field is presented. Tangible and reversible QY enhancements of ~20% are observed in NWs emission intensities with an applied voltage ranging from -100 to 100 V.

The effect is directly linked to field-induced changes of carrier detrapping rates from defect states responsible for non-radiative relaxation processes, namely a nanoscale Poole-Frenkel effect.
To more quantitatively rationalize the phenomenon, model that describes photogenerated carrier recombination dynamics (rate equation method) is applied. It is extended to account for field-enhanced carrier detrapping rates. To define actual electric filed experienced by NW we performed traditional procedure with Poisson equation. Both external and internal (built-in) electric fields are considered in tandem to explain the observations.

Literature

[1] Frenkel, J. Phys. Rev. **54,** 1938, 647