Ag-doped colloidal semiconductor nanocrystals

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We doped colloidal CdSe and PbSe semiconductor nanocrystals with Ag impurites and investigated their optical and electrical properties. Doping lead not only to dramatic changes but surprising complexity. The addition of just a few Ag atoms per CdSe nanocrystal caused a large enhancement in the fluorescence, reaching maximum efficiencies comparable to core-shell nanocrystals. While Ag was expected to be a substitutional acceptor, non-monoatomic trends in the fluorescence and Fermi level suggest that Ag changes from an interstitial (n-type) to a substitutional (p-type) impurity with increasing doping. In addition, temperature-dependent transport measurements were carried out using thin film transistors based on Ag-doped PbSe nanocrystal films. We observed shifts in the Fermi level due to doping. Also, the activation energy for hole transport was reduced with doping, which may result from a reduced Coulomb penalty for hopping.