Optoelectronic properties of strongly confined 2D HgTe nanoplatelets

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2D semiconductors nanoplatelets are a new class of nanomaterials. These nanoplatelets have demonstrated improved optical properties thanks to the atomic control of the confined direction (the thickness of the nanoparticles) leading to optical features with no inhomogeneous broadening. Nevertheless the nanoplatelets are mostly made out of cadmium chalcogenides meaning that there optical properties are in the visible range. Thus, reaching the infrared range is a new challenge. Here, we propose cation exchange on both CdSe and CdTe nanoplatelets toward mercury to synthesize HgSe and HgTe nanoplatelets[1]. These nanoplatelets have significantly improved optical properties compared to existing materials with similar band gaps (PbS or $CuInS_2$). The PL linewidth of three monolayers HgTe NPLs (40 nm full width half at half maximum for an emission centered at 880nm) is a factor of two smaller than the small PbS nanocrystals emitting at the same wavelength[2]. Moreover there emission lifetime (average lifetime of 55ns) is two orders of magnitude faster than those PbS quantum dots, which make us believe that mercury chalcogenides are near IR colloidal emitter ion with enhanced performances. In these nanoplatelets the confinement is so strong that the control of the surface chemistry can be used to tune the band gap of the material by controlling the wavefunction delocalization with the ligands. We also investigate the transport et electronic properties of the HgTe NPL. We in particular show that the nature of the majority carrier and photoresponse can be tuned thanks to surface chemistry and control of the fermi level [3].

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