

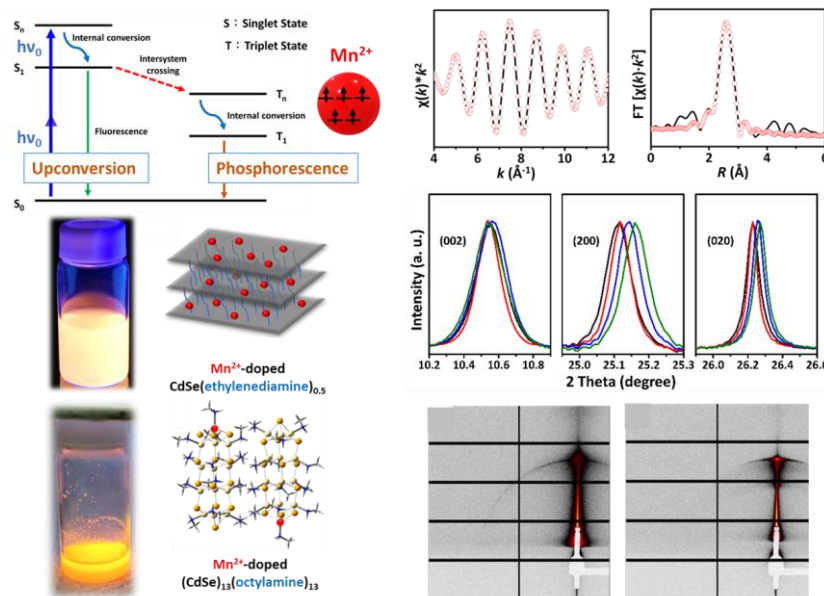
Structural Investigation of Quantum-Confined Semiconductors with Spintronic Properties

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Abstract

In NSRRC, three X-ray techniques, including diffraction (01C2, 09A), scattering (23A), absorption (16A, 01C1, 17C1), are employed to reveal crystal and electronic structures of quantum confined semiconductors. Three type of semiconductors (CdSe, ZnSe, CsPbBr₃) are synthesized via colloidal (30-250 °C) and chemical vapor deposition (700-800 °C) methods. Powder X-ray diffraction (PXRD) is a powerful tool to observe structure defects, lattice distortion as well as to estimate coherent lengths of crystalline domains. Grazing incidence small angle X-ray scattering (GISAXS) is a surface-sensitive scattering technique that probes orientation and periodicity of self-assembled nanostructure thin films from (CdSe)₁₃ and Poly(3-hexylthiophene) (P3HT). X-ray absorption techniques (XAS) include XANES and EXAFS that determine oxidation state, coordination numbers and bond distance of targeted metal centers which induce optical, spin, even spintronic phenomenon.

In our study, we are highly interested in optical (emission, lifetime), spin-induced magnetic (EPR, SQUID), and spintronic (MCD) of Mn-doped 2D nanosheets and perovskite semiconductors. Two photon absorption (upconversion), second harmonic generation (SHG) and anisotropic emission are observed in 2D materials with power- and temperature-dependent experiments. Large zero-field splitting in 2D monolayer CdSe(en)_{0.5} is given in the spin Hamiltonian with the best-fit D value 3850 MHz (1283x10⁻⁴ cm⁻¹) and the nearly zero E value in EPR spectrum. Giant Zeeman splitting with the record-high effective g-value (252), which is revealed in MCD spectra at room temperature. Doping of extrinsic ions is alternative convenient chemical processes of modifying electronic, optical and magnetic properties of semiconductors. NSRRC provides the state-of-the-art facility of X-ray diffraction, scattering, absorption techniques that help us to resolve the origins of quantum-confined semiconductors with spintronic properties.



Keywords -DMS, Phosphorescence, Magnetic, spin-orbit coupling.