Tailoring *sp-d* exchange coupling in CdSe/Mn:CdS core-shell nanoplatelets

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Recent advances in the colloidal nanoparticle chemistry enable the synthesis of highly anisotropic nanoplatelets from II-VI materials with pronounced characteristics of two-dimensional systems like distinguishable heavy hole and light hole transitions. [1] By colloidal atomic layer deposition, thickness and composition of these materials can be precisely controlled on the atomic scale and heterostructures with well-defined electron and hole wavefunction distribution become feasible. A remarkable recent progress is the successful transition metal doping of CdSe/CdS core shell nanoplatelets [2]. This introduces exchange coupling between the magnetic dopants and excited charge carriers, and it is currently discussed whether the magnetic interactions are restricted to localized rather than to free carriers [3].

Here we use the absorption-based technique of magnetic circular dichroism (MCD) to directly investigate the exchange interactions between magnetic dopants and different excitonic transitions in shell-doped type I CdSe/Mn:CdS nanoplatelets. Most important, the synthetic degree of freedom is utilized to selectively tune the overlap and thus the exchange interactions between the electrons and holes and the magnetic dopants . Pronounced MCD signals are found for a variety of excitonic resonances exhibiting a Brillouin-like temperature dependence, which is a specific signature of *sp-d* exchange interaction. A comparison between the magneto-optical features of the energetically lowest heavy hole and the light hole sub-bands indicates that the *s-d* exchange interaction is dominant for core transitions as the holes are mainly confined within the undoped CdSe core while the electron wavefunction extends to the Mn-doped CdS shell. We demonstrate that the strength of this *s-d* interaction can be tuned by varying the core thickness with monolayer accuracy. Excited level spectroscopy exhibits a branch of additional excitonic transitions. Hereby, the hole states are expected to become more delocalized thus interacting with the Mn-doped CdS shell and resulting in dominating *sp-d* exchange interaction. Our study not only evidences the opportunity to tune the exchange interactions between dopants and band charge carriers by a careful core-shell design in transition metal doped nanoplatelets, but in addition gives new insights into the excited stated electronic transitions in this novel 2-dimensional materials.

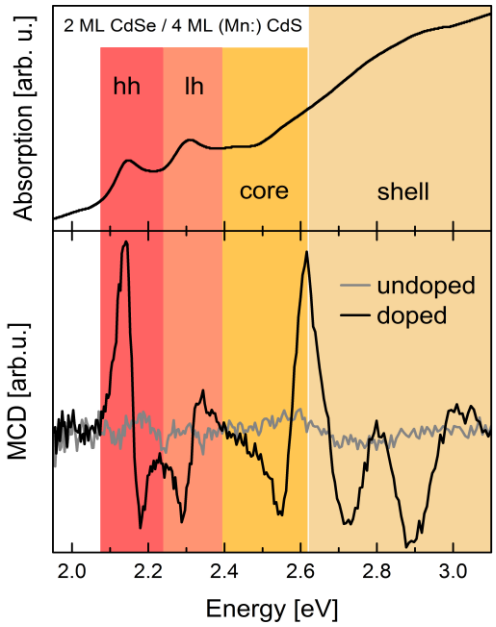

Fig. 1 MCD and absorption spectra of CdSe/Mn:CdS core-shell nanoplatelets

1) S. Ithurria *et al*., *Nature mater.*, **2011**, *10*, 936.
2) S. Delikanli *et al*., *ACS Nano*, **2015**, *9*, 12473.
3) J. Murphy *et al*., *Appl. Phys. Lett.*, **2016**, *108*, 242406.