Individual Cd(Se,Te)/ZnSe Quantum Dots: Beyond the Crossroad of Se and Te Based Quantum Dot Systems

M. Ściesiek[1], J. Suffczyński[1], W. Pacuski[1], M. Parlińska-Wojtan[2], T. Smoleński[1], P. Kossacki[1], and A. Golnik[1]

[1] *Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Pasteura 5 St., 02-093 Warsaw, Poland*

[2] *Institute of Nuclear Physics, Polish Academy of Sciences, Radzikowskiego 152 St., 31-342 Kraków, Poland*

Epitaxial Cd(Se,Te) Quantum Dots (QD) in ZnSe barrier exhibit typically a very high spectral density, which hinders investigation of a single dot photoluminescence.[1] Here, we design, grow and study individual Cd(Se,Te)/ZnSe QDs of low spectral density of emission lines achieved by implementation of a Mn-assisted growth.[2]

A large variation of parameters being a measure of electron-hole (*e-h*) wavefunctions overlap: exciton (X) radiative lifetime τ_X (280–620 ps), splitting between dark and bright exciton δ_0 (1.5–2.5 meV) and exciton-biexciton energy difference (3 meV $\leq \Delta E_{X-XX} \leq$ 26 meV) is found in the statistics of QDs. Such behavior, untypical for binary II-VI QDs is attributed to a strong variation from dot to dot of electron-hole (*e-h*) separation due to a different degree of localization of electrons and holes in, respectively, CdSe and CdTe rich QD regions. A significant correlation between the exciton radiative decay rate $(1/\tau_X)$ and the δ_0 (see Fig. 1a) confirms that dominating contribution to the δ_0 comes from a short-range component of the *e-h* exchange interaction. In contrary to a simple expectation, the Cd(Se,Te)/ZnSe QDs excitonic Landé factor g_X is smaller than Landé factors found previously in case of both, CdSe/ZnSe QDs and CdTe/ZnTe, binary type QD systems (see Fig. 1b). Additionally, a distinct and so far not observed for II-VI QDs, dependencies of the g_X and of the fine structure exchange splitting δ_1 on the ΔE_{X-XX} are found: the g_X increases, while the δ_1 decreases with the increasing ΔE_{X-XX}, that is with the increasing *e-h* wavefunctions overlap (see Fig. 1b). The obtained results demonstrate that values of the δ_1 and of the Landé factor in the studied QDs are dictated primarily by the electron and hole respective spatial shift and wavefunctions overlap.

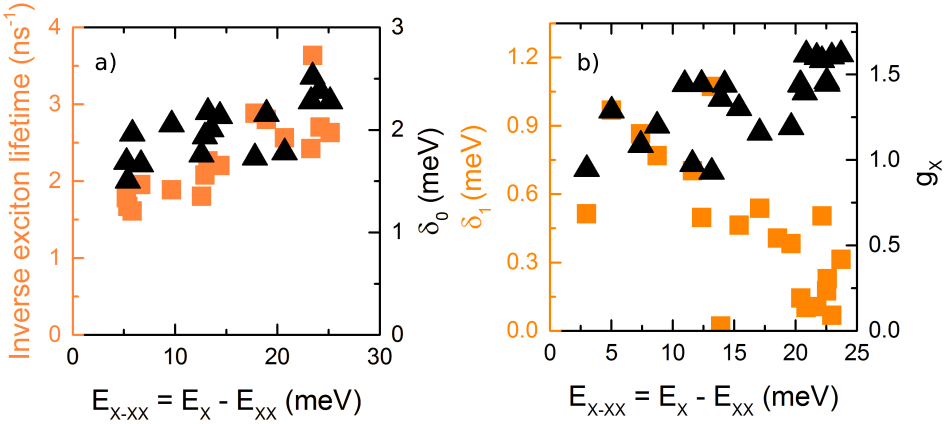

Figure 1: a) Inverse exciton lifetime and δ_0 splitting between bright and dark exciton as a function of energy difference between exciton and biexciton E_{X-XX}. b) Fine structure splitting δ_1 and exciton Landé factor g_X as a function of E_{X-XX}.

[1] A. A. Toropov *et al.*, Appl. Phys. Lett. 89, 123110 (2006).

[2] M. Ściesiek, J. Suffczyński, W. Pacuski, M. Parlińska-Wojtan, T. Smoleński, P. Kossacki, and A. Golnik, arXiv:1623.00313.