Single PbSe/CdSe quantum well studied by photoluminescence

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Motivation - why PbSe/CdSe QW ?

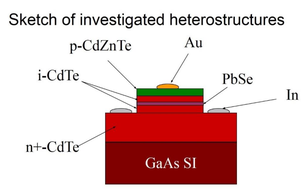
Semiconductor	Exciton Bohr radius (nm)	Exciton binding energy (meV)
GaN	2.4	27
CdTe	12.2	10.7
GaAs	11.2	4.9
PbSe	46	≤ 1

Low exciton binding energy

- strong quantum confinement
- quantum size effects in relatively wide QW

	PbSe	CdSe
4K	0.145 eV	1.74 eV
300K	0.280 eV	1.84 eV

Mid-Infrared sensors



Chusnutdinow, Szot et.al. AIP Advances (2017)

Possible alloying with:

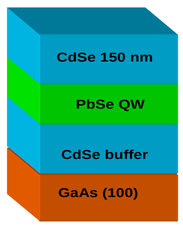
Cd

$E_{g\ PbSe}$

Sn

PbSnSe → Topological Crystalline Insulator

Samples grown by Molecular Beam Epitaxy

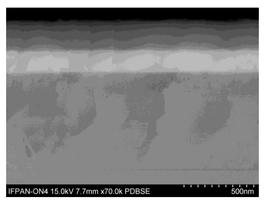


QW thickness
50 nm
70 nm
100 nm

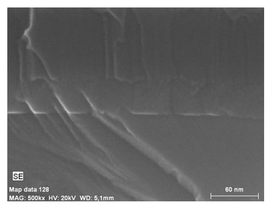
SEM cross-section images

backscattered electrons

CdSe barrier
PbSe QW
CdSe barrier

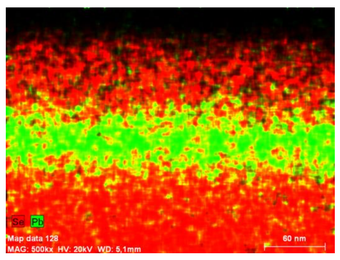


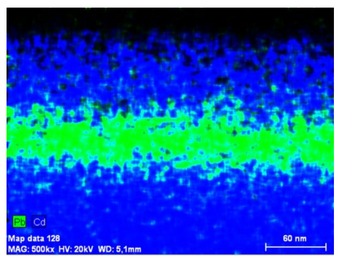
secondary electrons



Thanks to W. Zaleszczyk

EDX images

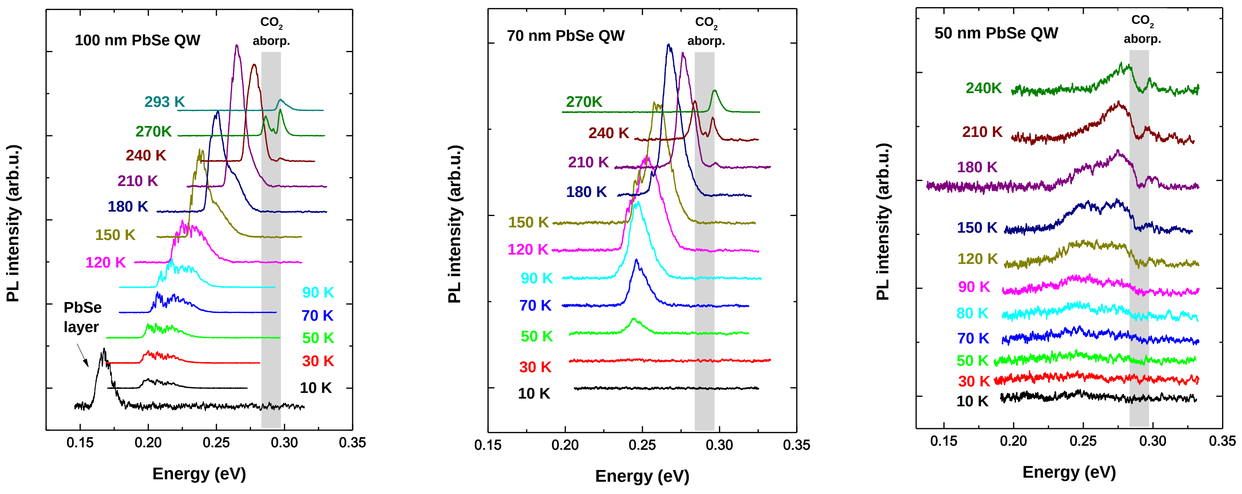




Photoluminescence

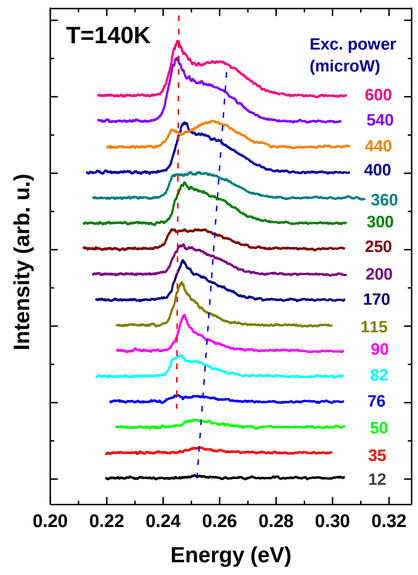
Temperature dependence

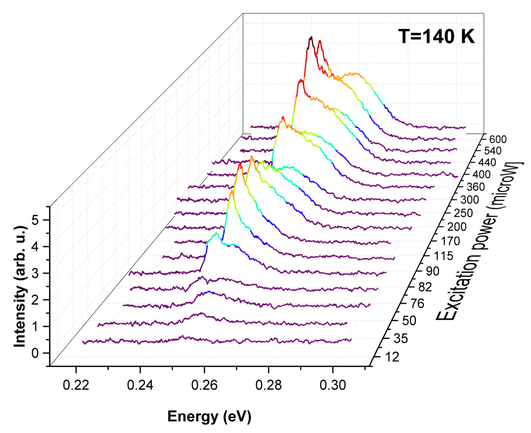
Measurements for PbSe QWs with different thicknesses



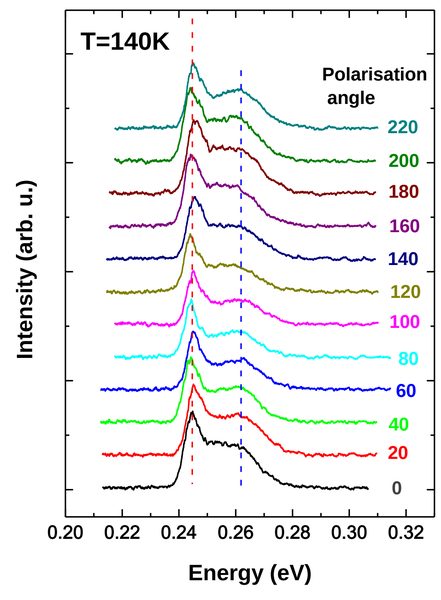
Excitation: 1064 nm line of pulsed Nd:Yag laser

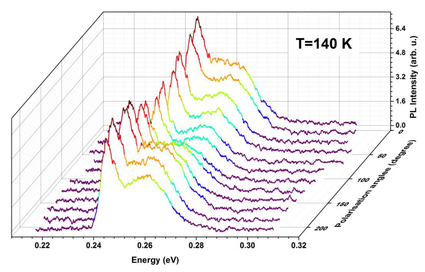
Power dependence for 70 nm QW

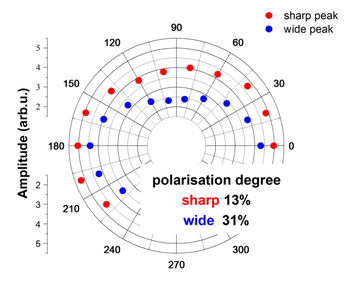




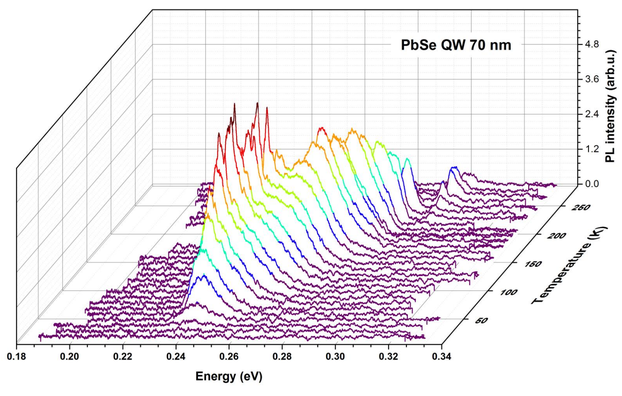
Polarization dependence

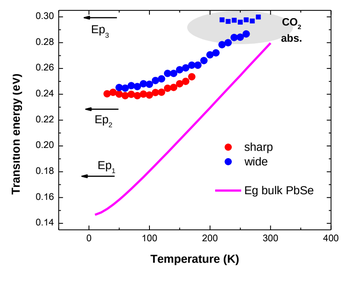


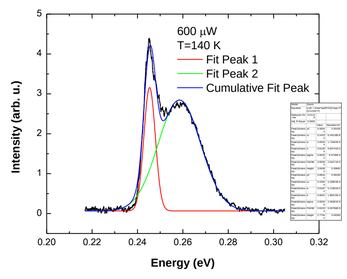


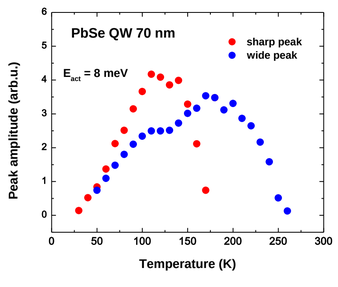


Temperature dependence for 70 nm QW

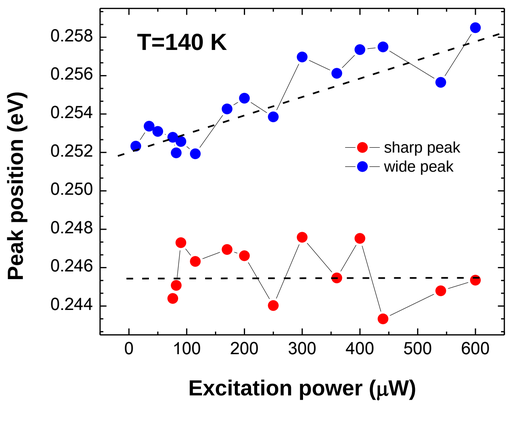




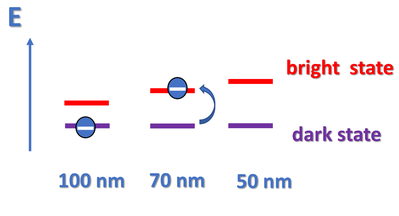




Photoluminescence – summary of results

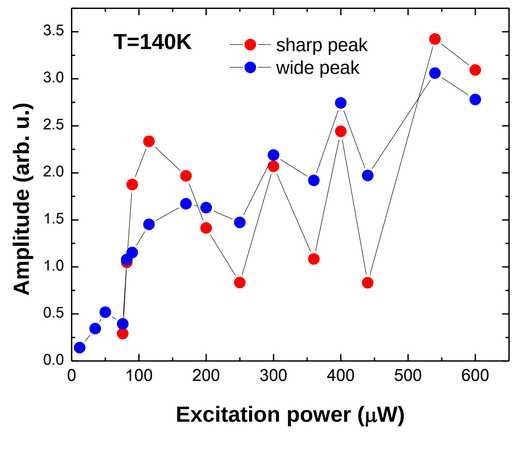


"band to band" transition



"excitonic-like" transition

Franceschetti and Zunger, Nano Lett. (2007)



Outlook

Magnetic field and life-time measurements should be performed to fully understand the nature of observed transitions