

## Raman spectroscopy investigations of heterostructured semiconductor nanocrystals

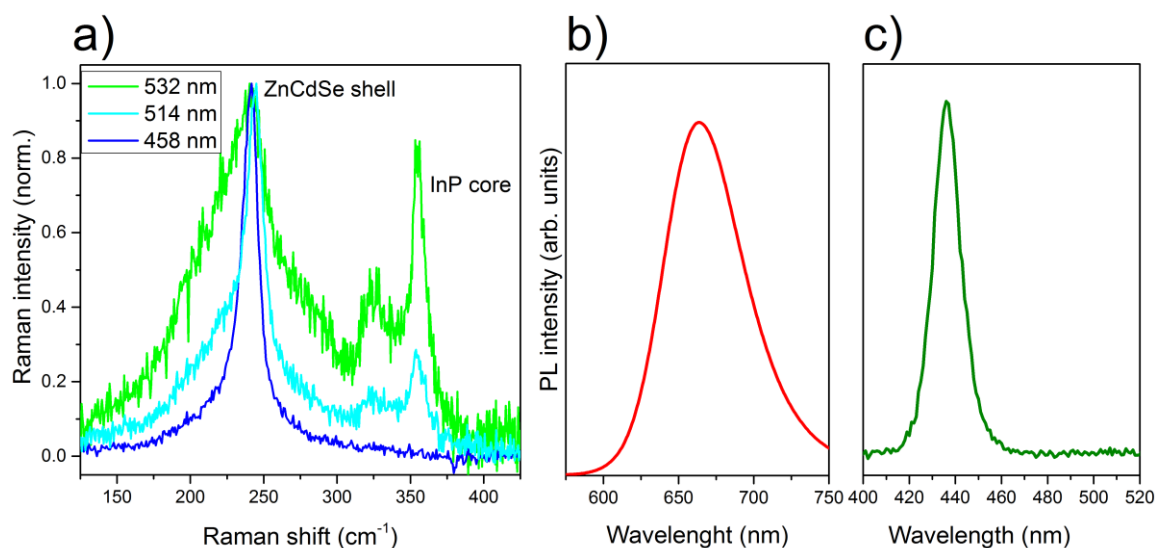
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Raman spectroscopy is frequently used to characterize colloidal semiconductor nanocrystals. For example, in core/shell nanocrystals, Raman spectroscopy allows to address core and shell in a single, non-destructive experiment, to quantize lattice strain and to characterize the interface between core and shell. [1] For the growth of alloyed structures, Raman spectroscopy allows to differentiate between developing core/shell and alloyed structures [2,3].



**Fig. 1** Raman spectra from InP/Zn<sub>0.75</sub>Cd<sub>0.25</sub>Se core/shell nanocrystals. The sample was excited with different wavelengths and the spectra were normalized to the shell-related band around 240 cm<sup>-1</sup>. b) Core related photoluminescence spectrum from the InP nanocrystals in a Zn<sub>0.75</sub>Cd<sub>0.25</sub>Se shell. c) Photoluminescence spectrum from an alloyed Zn<sub>0.75</sub>Cd<sub>0.25</sub>Se nanocrystal.

As core and shell materials of heterostructured nanocrystals have commonly very different bandgaps, they can be excited and monitored selectively in a resonant Raman scattering experiment, a method still rarely applied to nanocrystals.

As example material systems, CdSe and InP nanocrystals were investigated. For CdSe/CdS nanocrystals, Raman spectroscopy reveals an alloyed interface between core and shell. InP core nanocrystals were then directly embedded in alloyed Zn<sub>x</sub>Cd<sub>1-x</sub>Se shells. Fig. 1 displays exemplary Raman spectra. By monitoring changes in the spectra, we can demonstrate the successful growth of the homogeneously alloyed shell. We find a direct dependence of the lattice strain on the composition of the shell. In principle, a perfect lattice match and a strain free environment can be achieved.

Tuning the excitation wavelength towards the core resonance (Fig. 1 b) results in an increased intensity of the core-related Raman bands. If the excitation is tuned in resonance with the shell (Fig. 1 c), one obtains a well-resolved, intense spectrum of the shell and no resolvable Raman bands from the InP core. Systematic studies with excitations in full resonance can lead to isolated, high-quality spectra from both, core and shell. This way, resonant Raman scattering could enable an unparalleled view on core/shell systems.

1) N. Tschirner *et al.*, *Chemistry of Materials*, **2012**, *24*, 311.

2) T. Aubert *et al.*, *Chemistry of Materials*, **2013**, *25*, 2388.

3) C. Bothe *et al.*, *Angewandte Chemie International Edition*, **2015**, *54*, 14183.