Complex colloidal semiconductor quantum dots such as core/shell or core/crown nanoplatelets can now be synthesized. Achieving these heterostructures has improved greatly the optical properties of the colloidal quantum dots. The optical properties of these colloidal quantum dots will depend not only on the morphology of the heterostructure (in particular the size and the shape of the core), the chemical nature and the presence of a gradient at the interfaces, but also on the elastic deformation inside the quantum dots due to lattice mismatch between the materials. The study of these heterostructures by aberrations corrected Scanning Transmission Electron Microscopy (STEM) provides access to their structure until the atomic scale. High Angle Annular Dark Field STEM images allow direct access to the atomic structure of the nanoparticles, and the contrast of the columns of the atoms is linked on their chemical nature (“Z-contrast” images). From these atomic resolution STEM images, it is possible to establish the strain fields of the heterostructure. Moreover, we can achieve correspondingly chemical quantitative analysis by STEM-EDX with a spatial resolution of about 1nm. We show studies realized on CdSe/Cd(Zn)S core/shell nanoplatelets [1,2] and core/crown CdSe/CdS [3] and CdSe/CdTe.

[1] Core/Shell Colloidal Semiconductor Nanoplatelets
B. Malher, B. Nadal, C. Bouet, G. Patriarche, B. Dubertret

E. Cassette, B. Mahler, J.-M. Guigner, G. Patriarche, B. Dubertret, T. Pons
ACS NANO 6 (2012) 6741-6750

M. D. Tessier, P. Spinicelli, D. Dupont, G. Patriarche, S. Ithurria, B. Dubertret
NANO LETTERS 14 (2014) 207-213

Acknowledgement: This work was supported by the French National Agency for Research (ANR), project "SNAP", ANR-12-BS10-011
Fig. 1: HAADF-STEM image of a colloidal CdSe/Cd$_{0.7}$Zn$_{0.3}$S core/shell platelet vertically aligned following the <001> axis and the full-field strains ($\varepsilon_{xx}$, $\varepsilon_{yy}$ and $\varepsilon_{xy}$) mapped by using the geometric phase analysis (GPA). The core/shell structure is elastically matched in the plane (100) of the platelet and pseudomorphically relaxed along the <100> direction.

Fig. 2: Line profile extracted from the $\varepsilon_{xx}$ strain map, the value is averaged over a width of about 10nm. We measure a deformation of about 16% along the <100> direction. The difference between the lattice parameters of the two materials is about 8% (the composition of the shell Cd$_{0.7}$Zn$_{0.3}$S has been established by quantitative EDX analysis).