

Transformation of CdSe/ZnS QDs in surface water at environmentally relevant concentrations

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Engineered nanoparticles (ENPs) are highly susceptible to arrive to environmental compartments (*e.g.*, surface waters). However, studies on their fate and behaviour are often carried out at concentrations far from those predicted in real environmental media,¹ due to the difficulty to detect these NPs in complex matrices with high background noise (*i.e.*, the occurrence of NPs constitutive elements in the natural media in varying concentrations). Nevertheless, changes in NPs concentration are known to affect its physicochemical behaviour. Therefore, we propose in this study to use non-traditional stable isotopes (isotopically labelled² NPs) to overcome analytical barriers when working at relevant concentrations (ng/L).

The behaviour of 7 nm-sized multi-isotopically labelled ¹¹¹Cd/⁷⁷Se/⁶⁸ZnS quantum dots (QDs) coated with thioglycolic acid (TGA) was evaluated after dispersion at the ng/L level in different synthetic river waters (in absence and presence of fulvic acids and goethite). Metal solubility and speciation was assessed using centrifugal ultrafiltration (CU, 3kDa) in combination with HR-ICPMS and scanned stripping chronopotentiometry technique (SSCP). Whereas the SSCP provides the speciation accounting for the total labile metal in solution (Zn and Cd from QDs + natural Zn and Cd), the CU/HR-ICPMS gives information on dissolved fractions (smaller than 3kDa) issued from isotopically labelled QDs.

Particles dissolution and aggregation were affected not only by the physicochemical conditions of the water (including the presence of natural phases), but also by the presence of the manufactured coating of the QDs,³ and by the interaction of the metal ions with the coating itself. In addition, goethite plays a major role while sorbing most of Zn and Cd issued from the QDs dissolution and fulvic acids potentially form heteroaggregates with goethite and potentially non dissolved QDs. Our results demonstrated the advantage of the use of isotopically labelled NPs.

[1] Gottschalk, F. et al., 2009. *ES&T*, **43** (24), 9216–9222.

[2] Sivry, Y. et al., 2011. *ES&T*, **45** (15), 6247–6253.

[3] Domingos, R. F. et al., 2015. *ESPR*, **22** (4), 2900–2906.