Fate of CdSe-ZnS Quantum dots in soil water by Field-Flow Fractionation-based multi-technique strategy

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Quantum dots (QDs) are semiconductors used in electronics and biomedicine. The structure and composition of QDs raises concerns about their release into natural environments. Cadmium selenide-zinc sulphide (CdSe-ZnS) QDs are of particular concern because of the potential impact of their elements on ecosystems. However, little is known about their fate in soil waters.

In the present study, synthesized CdSe / ZnS core-shell QDs coated with polymer (P-QDs) was first characterized. For this, asymmetric flow-field flow fractionation (AF4) - multiangle light scattering (MALS) - inductively coupled plasma mass spectrometry (ICP-MS) was used. Indeed, such a selective and sensitive coupling enables the intrinsic parameters of the P-QDs, namely size, structure, composition and concentration to be determined. Dynamic light scattering (DLS) and transmission scanning electron microscopy (STEM) were used as complementary and validation techniques. The data processing of the elementary information obtained by AF4-ICPMS enabled three classes of well-resolved size populations to be identified in the suspension of P-QDs. Then, this suspension was introduced into soil water and the fate of the P-QDs was studied. Using the same analytical strategy, it was possible to quantitatively distinguish the types of P-QDs affected by the aggregation and / or dissolution processes in the soil water. This study therefore enables the potential of AF4-MALS-ICPMS for the characterization of nanoparticles in a complex medium to be illustrated and the fate of QDs in this medium to be better understood.