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One decade of research into the fate and transport of carbon-based nanomaterials – Lessons learnt and future perspectives

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Carbon-based nanomaterials (CNM) exhibit unique physico-chemical properties (e.g., large surface area to volume ratios, electron delocalization), which make them promising for a great number of applications. The production, use, and disposal of CNM and CNM-containing products will inevitably result in the release of these materials into the environment.

The fate and transport of CNM greatly depends on their physico-chemical properties and surrounding environmental conditions. This field of research has constantly increased over recent years. Yet little is known on how transformation processes such as changes in surface properties or aggregation influence their interaction with other environmental species (i.e. solid surfaces or contaminants). For example, changes in redox chemistry in combination with irradiation have shown to significantly alter the surface chemistry of C60 fullerenes and consequently decreased their sorption affinity towards non-polar organic contaminants [1]. The presence of natural organic matter (NOM) seems to play a major role on the aggregation of CNM; however, the results are not consistent whether this leads to an increase or decrease in interactions with solid surfaces or contaminants. Either increased interactions resulting from a higher dispersion of CNM or decreased interactions of CNM, which was assigned to an offset of “creating” new sorption sites due to increased dispersion by a reduced accessibility of polar moieties. For the latter effect, NOM was proposed to either directly compete for sorption sites on CNM surface or a blocking of CNM pores by large NOM molecules [2]. The potential consequences of these changes in surface properties of CNM on their toxic effects on microorganisms have only been partially examined.

For an environmental risk assessment, data on the occurrence of CNM is obligatory but to date the environmental concentrations of CNM are still difficult to assess due to still unsolved analytical issues in matrix separation and the discrimination of CNM from naturally present particles with similar dimensions and properties (e.g., soot or colloids). Recently, progress has been made to characterize the aggregation and to determine the occurrence of (functionalized) fullerenes using asymmetrical flow field-flow fractionation coupled to a LC-HR-MS [3].

In this contribution, the major results during the last decade of environmental research into CNM will be reviewed with the focus on their analyses and characterization, and interactions with solid surfaces.

References:
[1] Hüffer, T., Kah, M., Hofmann, T., Schmidt, T.C. (2013) How Redox Conditions and Irradiation Affect Sorption of PAHs by Dispersed Fullerenes (nC60). Environmental Science & Technology, 47(13), 6935-6942.

[2] Hüffer, T., Schroth, S., Schmidt, T.C. (2015) Influence of humic acids on sorption of alkanes by carbon nanotubes – Implications for the dominant sorption mode. Chemosphere, 119, 1169-1175.

[3] Kolkman, A., Emke, E., Bauerlein, P.S., Carboni, A., Tran, D.T., terLaak, T.L., vanWezel, A.P., deVoogt, P. (2013) Analysis of (Functionalized) Fullerenes in Water Samples by Liquid Chromatography Coupled to High-Resolution Mass Spectrometry. Analytical Chemistry, 85(12), 5867-5874.