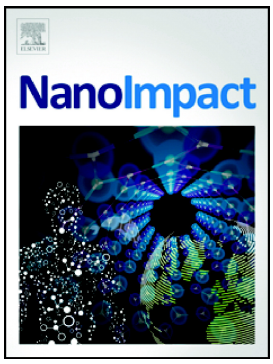

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Carbon nanomaterials differentially impact mineralization kinetics of phenanthrene and indigenous microbial communities in a natural soil

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Abstract

Previous reports on how carbon nanomaterials (CNMs) affect the biodegradation and mineralization of organic contaminants are mainly limited to pure culture studies, but little is known about the mineralization process by more complex and environmentally-relevant microbial communities. This study investigated the impact of fullerenes C_{60} and two multi-walled carbon nanotubes (outer diameter < 8 nm: M8; > 50 nm: M50) at 300 and 3000 mg/kg on the mineralization kinetics of ^{14}C-phenanthrene (18.5 mg/kg) by indigenous microorganisms in a natural soil for 120 days. Phenanthrene mineralization kinetics fitted well with the logistic growth equation regardless of the CNMs present (R^2 = 0.965-0.985). The maximum mineralization rates and the total mineralization fraction were positively correlated with the initial phenanthrene bioavailability, assessed via β-HPCD extraction. Phenanthrene exposure induced significant responses of the catabolic gene biomarker *nidA*, fungi and bacteria communities by 275, 30, and 5 times, respectively, indicating a non-neglectable role of the fungal communities in phenanthrene mineralization. CNMs exerted a sorption- and level-dependent suppression (7.4-47.2%) on the total phenanthrene mineralization fractions at 120 d. Carbon nanotubes (300, 3000 mg/kg) caused significant adverse effects on the biomass of bacterial (47.8-60.7%), fungal (31.4-71.6%) and *nidA*-carrying degraders (25.7-59.9%) in the absence or presence of phenanthrene, which contributed to the inhibition of the total mineralization fractions at