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Microplastic types dominate the effects of bismuth oxide semi-conductor nanoparticles on their transport in saturated quartz sand

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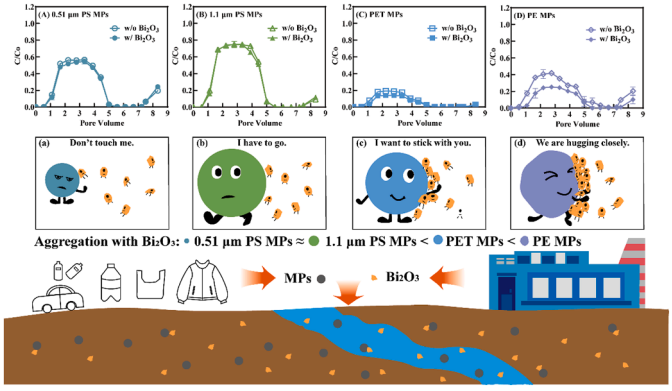
HIGHLIGHTS

- Semi-conductor Bi_2O_3 nanoparticles on PS, PET and PE MPs transport were studied.
- Novel electrochemical and DFT methods were employed for mechanisms exploration.
- Compared to PS and PET, PE MPs-Bi_2O_3 interaction was strongest by all measurements.
- MPs-Bi_2O_3 interactions were major factor for the effect of Bi_2O_3 on MPs transport.

GRAPHICAL ABSTRACT



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ABSTRACT

The transport of microplastics (MPs) is of great significance due to its potential threat to subsurface systems. The copresence of MPs and semi-conductor nanoparticles is quite common in practical environments (i. e. in electronic/electrical waste disposal sites). To date, the influence of bismuth oxide (Bi_2O_3) semi-conductor nanoparticles on MPs transport in porous media has still been rarely and explicitly explored. Therefore, the effect of Bi_2O_3 on the transport of distinct types of MPs were investigated using column experiments. The MPs included 0.51 μm and 1.1 μm polystyrene (PS), 1 μm polyethylene terephthalate (PET) and 1 μm polyethylene (PE) MPs. Mechanisms for the differently altered transport of various MPs with Bi_2O_3 were further elucidated. It was verified that the deposited Bi_2O_3 on sand surfaces could contribute to the decreased transport of PET and PE MPs by column experiments with pre-treatment. Moreover, scanning electron microscopy (SEM), dynamic light scattering (DLS) measurements, and electrochemical Nyquist curves demonstrated that the interaction of PE and

Abbreviation: MPs, Microplastics; PS, Polystyrene; PET, Polyethylene terephthalate; PE, Polyethylene; PP, Propylene; SEM, Scanning electron microscopy; DLS, Dynamic latering; DFT, Density functional theory; PCBs, Polychlorinated biphenyls; PBDEs, Polybrominated diphenyl ethers.

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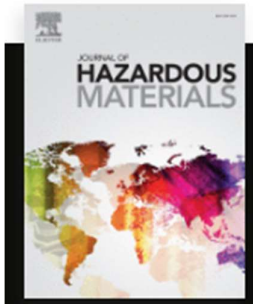

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