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Effects of biochar input on the properties of soil nanoparticles and dispersion/sedimentation of natural mineral nanoparticles in aqueous phase

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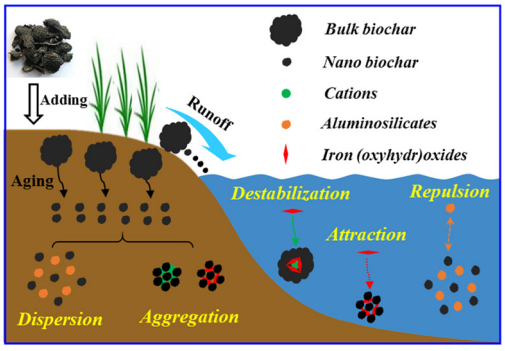
HIGHLIGHTS

- Bulk biochar increased C content but decreased Fe content in brown soil NPs.
- Bulk biochar did not influence elemental composition of laterite soil NPs.
- Bulk biochar was capable of capturing Goe and Hem NPs at solution pH 6.5.
- Nano biochar reduced dispersion of Goe and Hem NPs via heteroaggregation.
- Nano biochar barely associated with Kao and Mon NPs due to electrostatic repulsion.

GRAPHICAL ABSTRACT



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ABSTRACT

Upon addition to or otherwise entering soils and waters, biochar particles inevitably interact with natural mineral nanoparticles (NPs). We explored the impacts of two biochars made from charring peanut shells at 300 and 600 °C (P300 and P600) on the characteristics of soil NPs extracted from brown soil and laterite soil. The dispersion or sedimentation of montmorillonite (Mon), kaolinite (Kao), goethite (Goe), and hematite (Hem) in the aquatic phase were investigated in the presence of P300 and P600 or their nano samples (NP300 and NP600). P300 and P600 increased the organic C fraction in the soil NPs extracted from brown soil, and decreased the amount of Fe-associated NPs. However, no significant influence was observed in the organic C and mineral phases of laterite soil NPs by P300 and P600. Goe and Hem were slightly adsorbed to P300 at pH 6.5, while Goe or Hem homoaggregates formed and settled onto P600. NP300 and NP600 significantly reduced the dispersion of Goe and Hem in the aquatic environment via heteroaggregation, but there was no interaction between NP300 or NP600 and Mon or Kao. These findings are helpful for understanding the interaction between natural minerals and biochars, and the potential fate and ecological services of biochar-mineral complexes in soil and water.

1. Introduction

Natural nanoparticles (NPs) have existed from the beginning of Earth's history and are widely distributed throughout soils, waters, and sediments (Hochella et al., 2008; Theng and Yuan, 2008). Mineral

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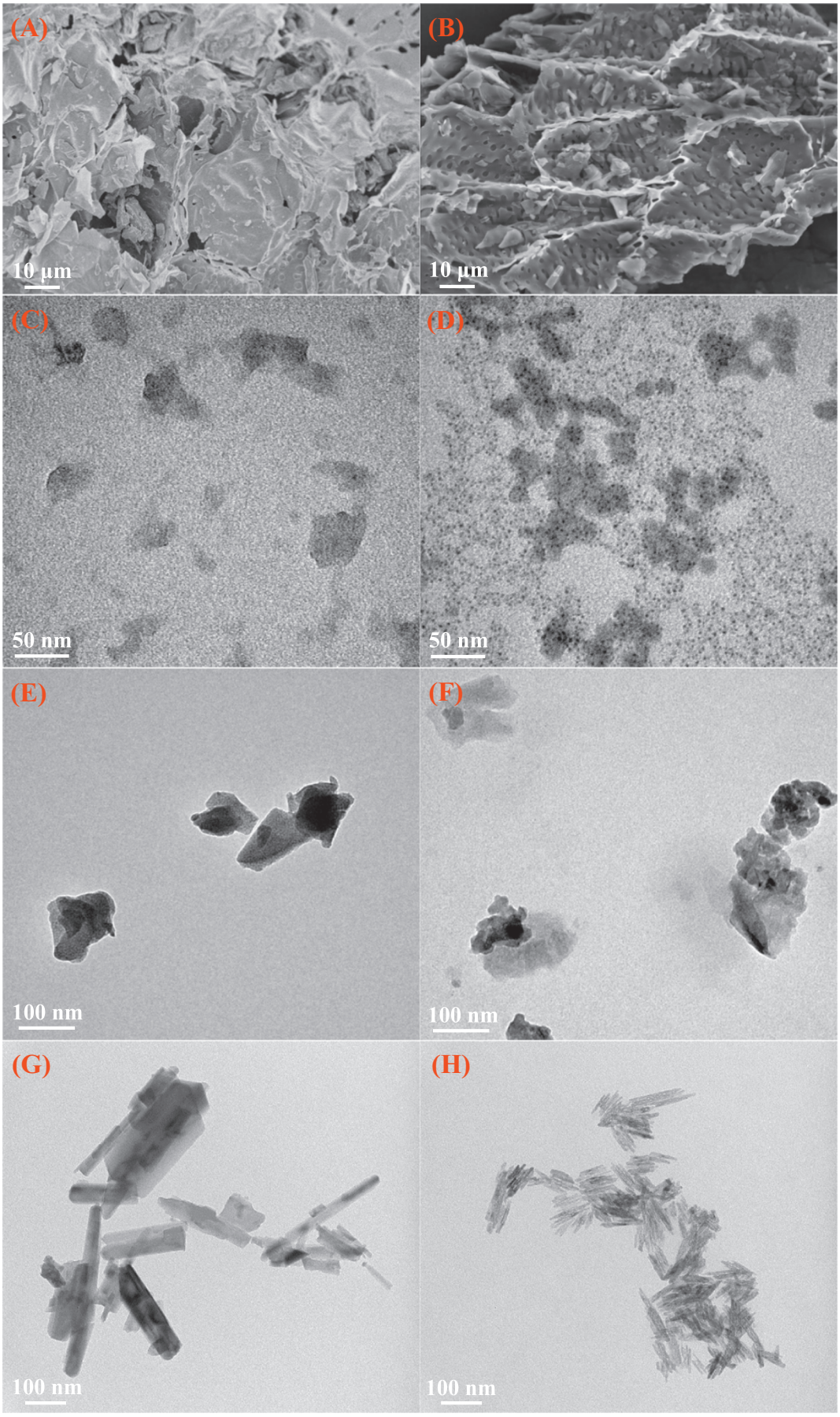
(A)
10 μm
(B)
10 μm
(C)
50 nm
(D)
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