

Dendrimeric Organic Nanomaterials at the Ferrihydrite-Water Interface: Size and pH Effects on Binding Dynamics

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As the nature and quantity of new/novel nanomaterials continue to expand to meet industrial, medical, and domestic demands, their accidental or intentional release becomes inevitable. To this end, an evolving understanding of the interaction dynamics between nanomaterials and naturally-occurring geomaterials is central to supporting continued sustainable development and use of nanomaterials. The current study explores the chemodynamics of the organic nanomaterial, polyamidoamine (PAMAM), binding to (and debinding from) ferrihydrite. Specific focus is placed on how PAMAM size and reaction pH affects the quantity, kinetics and dynamics for three carboxyl-terminated PAMAMs (G_x.5-COOH) sorbing/desorbing to/from the variably-charged ferrihydrite (FFH).

At pH 5, where the studied PAMAMs (G_{1.5}-COOH, G_{3.5}-COOH and G_{5.5}-COOH) exist in zwitterionic form and the FFH is positively charged; the smaller PAMAMs (i.e. G_{1.5}-COOH and G_{3.5}-COOH) sorbed/desorb to/from FFH in similar quantities but at slower rates than G_{5.5}-COOH. Sorption/desorption was also found to occur via 1- or 2-steps with a faster surface-mediated step being followed by a slower diffusion-mediated step and the proportion of surface-mediated: diffusion-mediated sorption/desorption increasing with PAMAM size (i.e. G_{1.5}-COOH < G_{3.5}-COOH < G_{5.5}-COOH)

The presentation will further cover results obtained at pH 3 and pH 7; where both the speciation of the PAMAMs and/or surface charge of the FFH will be significantly different than at pH 5.