

Report as of FY2010 for 2007MA73B: "Environmental Behaviors of Engineered Nanoparticles in Water"

Publications

. SEE BELOW

Report Follows

Methodology

Batch sorption techniques, DSL, liquid scintillation counting, HPLC detection, TEM, AFM and SEM examinations.

Principal Findings and Significance

The colloidal stability of three structurally different humic acid (HA) coated Al₂O₃ nanoparticles (HAs-Al₂O₃ NPs) was studied in the presence of Ca²⁺. HAs were obtained after sequential extractions of Amherst Peat Soil. Highly polar HA1-coated Al₂O₃ NPs exhibited strong aggregation in the presence of Ca²⁺. HA3 and HA7-coated NPs showed weaker aggregation due to their increased aliphaticity and low polarity. HA7-Al₂O₃ NPs displayed the weakest aggregation behavior even at relatively high Ca²⁺ concentration. The inverse stability ratio ($\alpha=1/W$) was the lowest for HA7-Al₂O₃ NPs reflecting that strong steric stabilization enhanced colloidal stability. Atomic force microscopy (AFM) of pure Al₂O₃ NPs on Ca²⁺-saturated mica clearly demonstrated significant aggregation following classical DLVO model for hard spheres. On the contrary, weakly polar HA fraction produced approximately 10 nm thick corona of adsorbed layer around each Al₂O₃ NP, thus, stabilizing coated NPs suspension through steric effect. Under alkaline conditions and at low ionic strength adsorbed HA chains swelled, increasing their osmotic potential, which in turn resulted in stabilization of the colloids. Inherent structural variations of NOMs played a significant part in colloidal stability of the coated NPs. Thus, development of sterically stabilized NPs may have potential application for water remediation in marine and high salinity conditions.

Publications and Conference Presentations

Several Platform and poster presentations will be given at the International Conference of Environmental Application and Implication of Nanotechnology, June 9-11, 2009, Amherst, MA.

Articles in Refereed Scientific Journals

- Ghosh, S., Hamid Mashayekhi, P. Bhowmik and B. Xing. 2010. Colloidal stability of Al₂O₃ nanoparticles as affected by coating of structurally different humic acids. *Langmuir*, 26 (2): 873–879.
- Yang, K. and B. Xing. 2009. Sorption of phenanthrene by humic acid-coated nanosized TiO₂ and ZnO. *Environ. Sci. Technol.* 43(6): 1845-1851.
- Yang, K., D.H. Lin and B. Xing. 2009. Interactions of humic acid with nanosized inorganic oxides. *Langmuir*, 25(6): 3571-3576.
- Lin, D.H., N. Liu, K.Yang, L.Z. Zhu, Y. Xu and B. Xing. 2009. The effect of ionic strength and pH on the stability of tannic acid-facilitated carbon nanotube suspensions. *Carbon*, 47: 2875-2882.
- Yang, K. and B. Xing. 2009. Adsorption of fulvic acid by carbon nanotubes from water. *Environ. Pollut.* 157: 1095-1100.

Dissertations

"Influence of Natural Organic Matter and Synthetic Polyelectrolytes on Colloidal Behavior of Metal Oxide Nanoparticles" Ph.D. Dissertation by Saikat Ghosh. UMass.

Conference Proceedings

- Mashayekhi, H. S. Ghosh and B. Xing. "Aggregation Behavior of C60 Fullerene Water Suspension in the Presence of Natural Organic Materials." International Conference on the Environmental Implications and Applications of Nanotechnology, Amherst (MA), June 9-11, 2009, p. 36.

Iorio, M., A. De Martino, R. Capasso and B. Xing. "Screening of nine different nanoparticles for the removal of MCPA from water." International Conference on the Environmental Implications and Applications of Nanotechnology, Amherst (MA), June 9-11, 2009, p. 49.

Zia, J., D. Amarasiriwardena and B. Xing. "Investigation of the adsorption characteristics of Sb, Cd, and pB by nano- and micro-particle titania." International Conference on the Environmental Implications and Applications of Nanotechnology, Amherst (MA), June 9-11, 2009, p. 51.

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