SESE Seminar Abstract

2017.10.12.(Thursday)

The aggregation and long-term (25 d) sedimentation behaviors of reduced graphene oxide (RGO) and its three successively self-assembled nanohybrids (NHs) with magnetite (Fe_3O_4) and zerovalent silver (Ag^0) nanoparticles (NP) were investigated. The aggregation behaviors of the nanomaterials in NaCl and $CaCl_2$ electrolyte solutions were found to be in good agreement with Derjaguin–Landau–Verwey–Overbeek (DLVO)-type interactions and the Schulze-Hardy rule. The estimated ranges of Hamaker constants for RGO–based NHs (RGO/Fe_3O_4, RGO/Ag^0, and RGO/Fe_3O_4/Ag^0) lie between those of individual NP components (RGO, Fe_3O_4, and Ag^0). The dispersion of well-dispersed RGO and its NHs was assessed under various pH, salt type, ionic strength (IS), and natural organic matter (NOM) conditions, as illustrated in Figure 1a. The stability decreased with increasing the ratios of the edge-based surface functional groups (C(O)O and C=O) of RGO quantified by X-ray photoelectron spectroscopy analysis (Figure 1b).

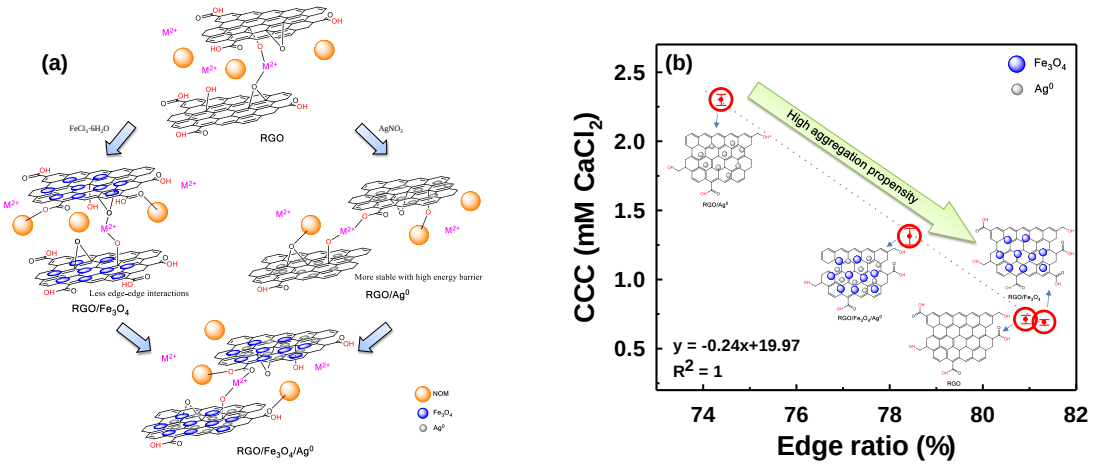

Figure 1 (a) Schematic showing the interaction mechanisms of RGO nanosheets loaded with Fe_3O_4 and Ag^0 NPs in the presence of divalent cations and NOM. (b) Linear relationship between the critical coagulation concentrations of RGO and its NHs and edge–based surface functional groups identified by XPS in $CaCl_2$ solution.

The transport and retention of the multifunctional carbon nanotube-magnetite NHs stabilized by carboxymethylcellulose (CMC-CNT-Fe_3O_4) were investigated in water-saturated porous media (sand) under environmentally relevant conditions. The transport of the magnetic CMC-CNT-Fe_3O_4 NHs was lower than that of the parent CNT due to a greater aggregation tendency (induced by magnetic attraction). The transport and retention behaviors of NHs can be interpreted by classical DLVO theory in which the secondary energy minimum played dominant roles in the retention of NHs. The column breakthrough curves revealed a novel feature; frequent sharp peaks followed by an initial low peak. The magnitude and location of those different transport peaks were determined by the interplay between variability of the fluid viscosity and aggregation-dispersion nature of the NHs under various experimental conditions.