

Development of a reduced-graphene-oxide based superparamagnetic nanocomposite for the removal of nickel (II) from an aqueous medium via a fluorescence sensor platform

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Abstract

Reduced-graphene-oxide based superparamagnetic nanocomposite (GC) was fabricated and applied for the remediation of Ni(II) from an aqueous medium. The as-prepared GC was extensively characterized by Raman, TEM, AFM, SEM–EDX, SQUID, and BET analyses. Quantitative immobilization of Ni(II) in an aqueous solution by the fluorescent sensor platform of GC was explored at varying pH, doses, contact times, and temperatures. The pseudo-second-order kinetics equation governed the overall sorption process at optimized pH of 5 (± 0.2). The superior monolayer sorption capacity was 228 mg g^(sup-1) at 300 K. Negative $G(\text{sup}0)$ indicated the spontaneous sorption nature, whereas the positive $H(\text{sup}0)$ resulted from an increase in entropy (positive $S(\text{sup}0)$) at the solid–liquid interface during the endothermic reaction. The lower enthalpy agreed with the relatively high regeneration (approximately 91%) of the GC by 0.1 M HCl, because of the formation of stable tetrahedral complex. The physisorption was well corroborated by calculated sorption energy ($E(\text{subDR}) \sim 7 \text{ kJ mol}(\text{sup-1})$) and the nature of the Stern–Volmer plot of the fluorescence-quenching data with reaction time. The GC played a pivotal role as a static fluorescent sensor platform (fluorophore) for Ni(II) adsorption. Magnetic property also indicated that GC could be easily separated from fluids by exploiting its superparamagnetic property.