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Synthetic Bis(2-Pyridylmethyl)Amino-Chloroacetyl Chloride-Ethylenediamine-Grafted Graphene Oxide Sheets Combined with Magnetic Nanoparticles: Remove Metal Ions and Catalytic Application

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Abstract : In this research, the functionalization of graphene oxide sheets by ethylenediamine (EDA) was accomplished and followed by the grafting of bis(2-pyridylmethyl) amino group (BPED) onto the activated graphene oxide sheets in the presence of chloroacetylchloride (CAC) and then combined with magnetic nanoparticles (Fe_3O_4NPs) to produce a magnetic graphene-based composite [(Go-EDA-CAC)@Fe_3O_4NPs-BPED]. The physicochemical properties of [(Go-EDA-CAC)@Fe_3O_4NPs-BPED] composites were investigated by Fourier transform infrared (FT-IR), scanning electron microscopy (SEM), X-ray diffraction (XRD), thermogravimetric analysis (TGA). Additionally, the catalysts can be easily recycled within ten seconds by using an external magnetic field. Moreover, [(Go-EDA-CAC)@Fe_3O_4NPs-BPED] was used for removing Cu(II) ions from aqueous solutions using a batch process. The effect of pH, contact time and temperature on the metal ions adsorption were investigated, however weakly dependent on ionic strength. The maximum adsorption capacity values of Cu(II) on the [(Go-EDA-CAC)@Fe_3O_4NPs-BPED] at the pH of 6 is 3.46 mmol.g^{-1}. To examine the underlying mechanism of the adsorption process, pseudo-first, pseudo-second-order, and intraparticle diffusion models were fitted to experimental kinetic data. Results showed that the pseudo-second-order equation was appropriate to describe the Cu (II) adsorption by [(Go-EDA-CAC)@Fe_3O_4NPs-BPED]. Adsorption data were further analyzed by the Langmuir, Freundlich, and Jossens adsorption approaches. Additionally, the adsorption properties of the [(Go-EDA-CAC)@Fe_3O_4NPs-BPED], their reusability (more than 6 cycles) and durability in the aqueous solutions open the path to removal of Cu(II) from water solution. Based on the results obtained, we report the activity of Cu(II) supported on [(Go-EDA-CAC)@Fe_3O_4NPs-BPED] as a catalyst for the cross-coupling of symmetric alkynes.

Keywords : graphene, magnetic nanoparticles, adsorption kinetics/isotherms, cross coupling
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