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Biomaterial functionalized graphene-magnetite nanocomposite: A novel approach for simultaneous removal of anionic dyes and heavy metal ions

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Despite of immense application potential of graphene in wastewater treatment, the colloidal stability, aggregation and recyclability remain a major challenge. To address this issue, we report biomaterial functionalized graphene-magnetite (*Bio-GM*) nanocomposite as a novel recyclable material for treatment of wastewater containing dyes and heavy metal. The integration of biomaterial including living cells of *Shewanella oneidensis* with graphene-magnetite nanocomposite has been characterized through UV-Vis, FTIR, FESEM and fluorescent microscopic studies. The contact angle measurement depicts the hydrophilic property (water contact-angle 27.93), while VSM result demonstrates the super-paramagnetic behavior of the nanocomposite with saturation magnetization value of 30.2emu/g. The *Bio-GM* nanocomposite exhibits excellent adsorption capacity towards dyes and Cr^{6+} in both single and multicomponent system with removal capacity of 189.63±7.11 and 222.2±8.64mg/g of dyes and Cr^{+6}, respectively in the multicomponent dye-heavy metal system, suggesting selective binding capacity and high adsorption efficiency of *Bio-GM* nanocomposite. In the adsorption coupled redox reaction, the Cr^{+6} is reduced to Cr^{+3} through the biocatalytic activity of *Bio-GM* nanocomposite. The nanocomposite is easily regenerated and reused for multiple cycles of adsorption-desorption studies without the release of graphene and magnetite and thus eliminating the potential hazardous risk of nanomaterial to the environment. The proposed biomaterial functionalized graphene-magnetite nanocomposite thus offers a novel way for sustainable, affordable and efficient removal of coexisting toxic pollutants of dyes and heavy metal.

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