Advanced

Outline

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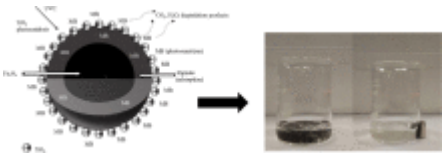
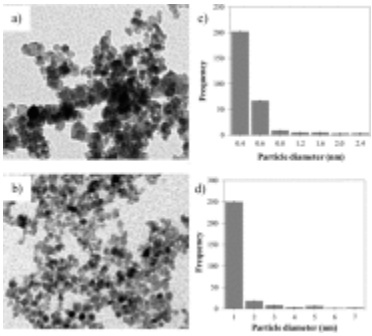
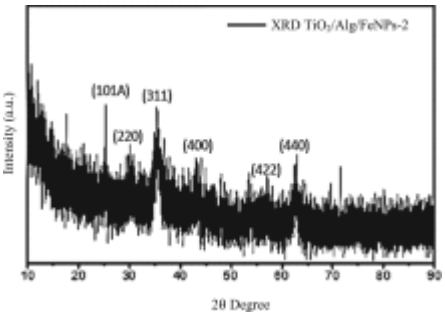
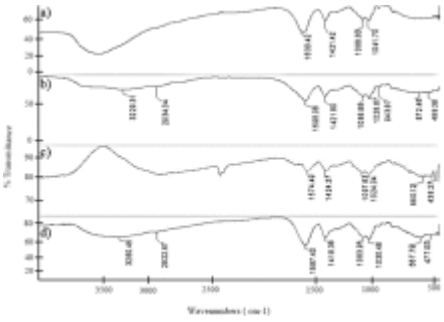
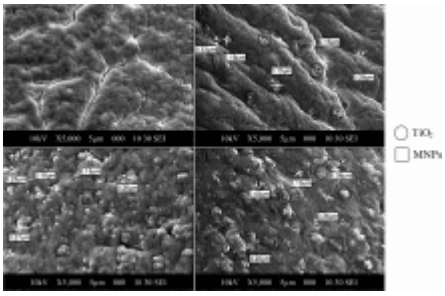
Figures (11)

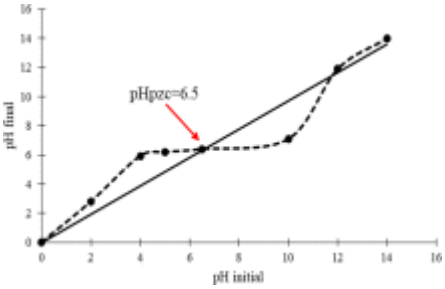
1. 

2. 

3. 

4. 

5. 

6. 

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Extras (1)

1. Supplementary material

Sustainable Chemistry and Pharmacy
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Magnetic hybrid TiO_2/Alg/FeNPs triads for the efficient removal of methylene blue from water

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Highlights

- An efficient direct method addition was applied to synthesize TiO_2/Alg/FeNPs beads.
- Adsorption, photocatalysis and magnetic property facilitated methylene blue removal.
- Alginate impeded low photoactivity of TiO_2/Alg/FeNPs beads by separating Fe_3O_4 and TiO_2.

Abstract

A new adsorbent material with combined adsorption, photocatalytic, and magnetic properties has been successfully synthesized and tested for the efficient dye removal from methylene blue (MB) contaminated water. A facile non-thermal method was applied to synthesize a hybrid nanocomposite consisting of TiO_2/calcium alginate (TiO/Alg) and magnetite (Fe_3O_4) nanoparticles (FeNPs). The potential of the adsorbent Alg as a barrier to prevent direct contact between the magnetic core and TiO_2 was experimented by varying the synthesis conditions. The performance of four differently synthesized TiO_2/Alg/FeNPs samples (TiO_2/Alg/FeNPs-1, TiO_2/Alg/FeNPs-2, TiO_2/Alg/FeNPs-3, and TiO_2/Alg/FeNPs-4) was found to be fairly comparable and stable based on their efficiency in removing MB from aqueous solution due to the physico-chemical characterization (surface morphology, functional groups and elemental analysis) which supports the performance of TiO_2/Alg/FeNPs. For the optimization study using the response surface methodology (RSM) with three factorial Box-Behnken experimental designs, TiO_2/Alg/FeNPs-2 was selected as it exhibited the highest MB removal of 97.6% after 120 min under ultra violet irradiation (254 nm wavelength). Among the three independent variables studied (i.e., pH, contact time and initial MB concentration), the initial concentration of MB had significant effect towards the MB removal performance. A recycling study was performed, thus confirming the stability of TiO_2/Alg/FeNPs-2 up to three cycles, with only a slight drop in the removal efficiency from 93.1% to 88.5%. The fabricated TiO_2/Alg/FeNPs nanocomposites could be a potential functional material for treating artificial dye laden wastewater such as in textile, cosmetic, and paper industries.