

Magnetic NiFe₂O₄ decorated-exfoliated graphite for adsorptive removal of anionic dyes and cationic dyes from aqueous solution

Bui Thi Phuong Quynh^{a,*}, Sang Hoon Kim^{b,*}, Doan Thi Que Minh^c,
Nguyen Thi Mong Diep^c, Pham Van Thinh^d, Nguyen Thi Thuong^a

^aFaculty of Chemical Engineering, Ho Chi Minh City University of Food Industry, Ho Chi Minh City 705800, Vietnam, Tel. 84-8-38161673, Fax 84-8-3816-1673, email: phuongquynh102008@gmail.com, quynhbtp@cntp.edu.vn (B.T.P. Quynh)

^bCenter for Materials Architecturing, Korea Institute of Science and Technology, Seoul 136-791, Korea, Tel. 82-2-958-5426, Fax 82-2-958-5391, email: kim_sh@kist.re.kr (S.H. Kim)

^cNTT Institute of Hi-Technology, Nguyen Tat Thanh University, Ho Chi Minh City 702000, Vietnam, Tel. 84-8-3940-5875, Fax 84-8-3940-4759, email: thuong.ngt88@gmail.com (N.T. Thuong), Mp.minh87@gmail.com (D.T.Q. Minh), nguyenthimongdiep05@gmail.com (N.T.M. Diep)

^dFaculty of Food Technology, Environment and Nursing, Dong Nai University of Technology, Bien Hoa City 810000, Dong Nai, Tel. 84-61-3996-473, Fax 84-61-3996-915, email: phamvanthinh27@gmail.com (P.V. Thinh)

Received 14 February 2017; Accepted 15 May 2017

ABSTRACT

This study focused on the fabrication, characterization of magnetic NiFe₂O₄-decorated exfoliated graphite (MEG) as well as its potential application as a low-cost, flexible and efficient adsorbent to remove different kinds of cationic and anionic dyes from aqueous solution. The exfoliated graphite was first fabricated using highly efficient microwave-assisted exfoliation technique and the ferrite magnetic component (NiFe₂O₄) was then introduced to the graphitic structure by sol-gel process. The materials were characterized using relevant analytical techniques such as scanning electron microscope (SEM), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), N₂ adsorption measurement and vibrating sample magnetometry. The adsorption behavior of widely used ionic dyes including methylene blue (MB), crystal violet (CV), methyl orange (MO) and congo red (CR) was investigated under effects of exfoliation degree, NiFe₂O₄ loading on EG structure, preparation temperature and adsorption conditions (i.e. pH and dye concentration). The adsorption mechanism was discussed taking into account the electrostatic force, hydrogen bonding, π - π interaction between delocalized π electrons of the basal planes and free electrons of aromatic rings and multiple bonds in dye molecules.

Keywords: Ionic dyes; Exfoliated graphite; Adsorption; Magnetic adsorbent; Nickel ferrite; Wastewater treatment

*Corresponding authors.