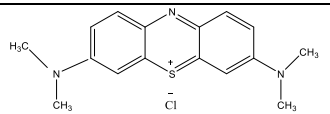
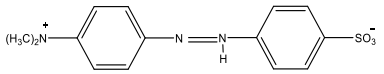
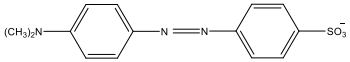
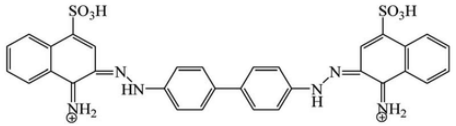
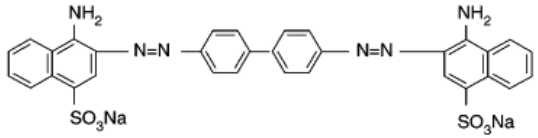
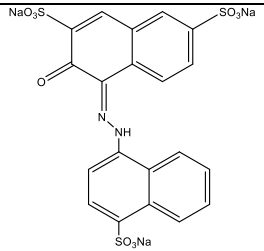
SUPPORTING INFORMATION

Graphene Oxide/Fe_3O_4/Chitosan−Coated Non−woven Polyester Fabric Extracted from Disposable Face Mask for Enhanced Efficiency of Organic Dye Adsorption

Hoang V. Tran [1,♣], Nhan T. Hoang [1], Thu D. Le [1], Luyen T. Tran [1], Hue T. M. Dang [1]

[1] School of Chemical Engineering, Hanoi University of Science and Technology, 1 Dai Co Viet Road, Hanoi, Vietnam

Table IS.1. *Molecular structure and some specific properties of MB, MO, CR and RS*

Dye	***Molecular structure***	***Type of organic dyes***	***Chemical and physical properties***	***Applications***	***Harmful in waste water***	***Refs.***
Metylen blue (MB)		Cation	M_w = 319.85 g mol^{-1}, solubility in water (pH 7; 25 ° C): 33.5 g l^{-1}	Colorant for dyeing, leather, wood, printing ink, chemical field, biomedicine, aquaculture.	Cause eye, skin diseases, even cancer, prevent of oxygen absorption of aquatic organism.	[1-3]
Methyl Orange (MO)	Acidic environment  Neutral and base 	Cation/anion Anion	M_w = 327.34 g mol^{-1}, Solubility in water (pH 7; 25°C): 5 g l^{-1}	Indicator , dyeing animal fiber, wool, silk, synthetic fiber.	Strong toxicity, causing skin diseases in contact, affect many organs and in some cases it can cause deaths.	[4, 5]
Congo Red (CR)	Acidic environment  Neutral and base 	Cation Anion	M_w = 696.67 g mol^{-1}; solubility in water (pH 7; 25 °C): 25 g l^{-1}	Indicator, use in paper, textile, rubber, gram staining.	Causes skin disease, cancer, reduce oxygen and sunlight absorption..	[6-9]
Moderacid red (RS)		Anion	M_w = 604.48 g mol^{-1}; solubility in water (pH 7; 25°C): 80 g l^{-1}	Dyeing for wool, nylon, plastic, paper, food coloring, cosmetic, animal feed.	May cause tumors, allergies, respiratory problem.	[4, 10-12]

1. Characterizations of synthesized graphene oxide (GO)

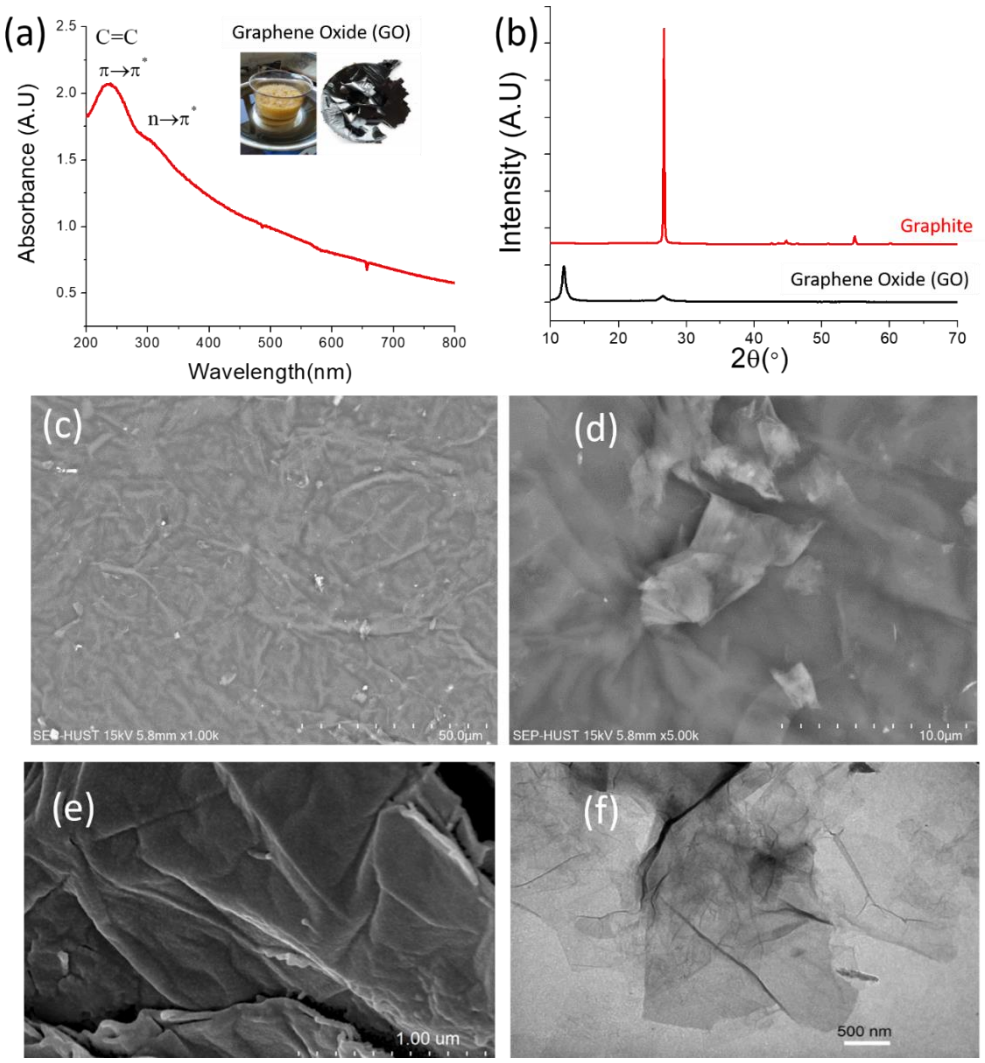


Figure SI.1. Characterizations of GO: (a) UV-Vis spectrum (inserted figure: digital photo of GO solution and GO flakes); (b) XRD; (c, d) SEM; (e) FE-SEM and (f) TEM images

2. FT-IR of CS and GFC

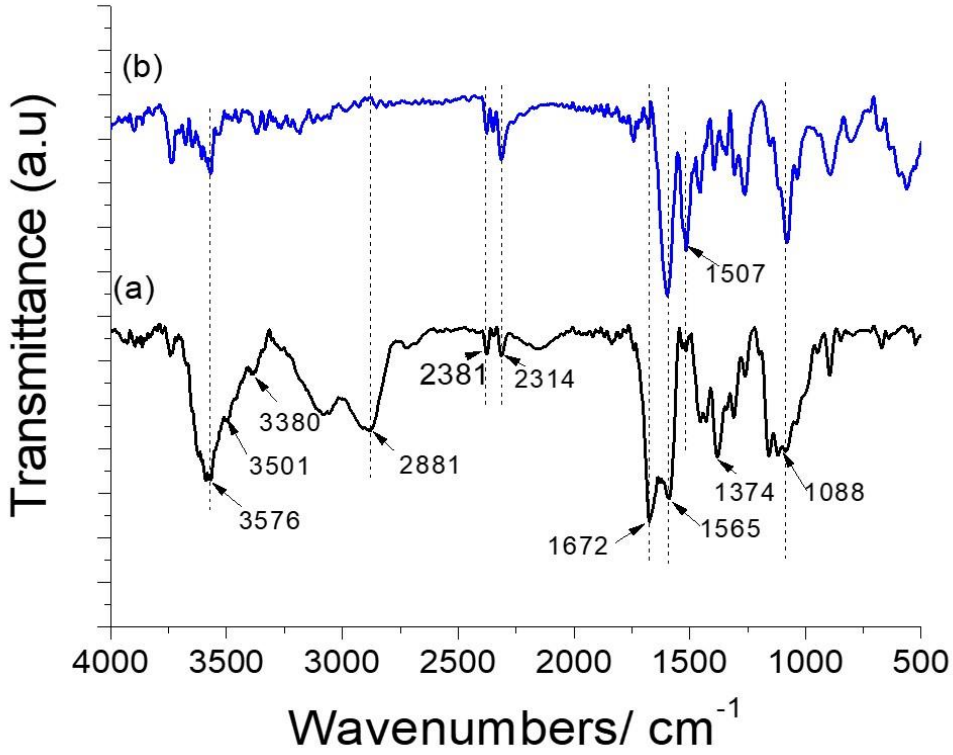


Figure SI.2. FT-IR spectra of: (a) chitosan (CS) and (b) graphene oxide/Fe_3O_4/chitosan (GFC)

2. Calibration curve for determine methyl orange (MO) concentration

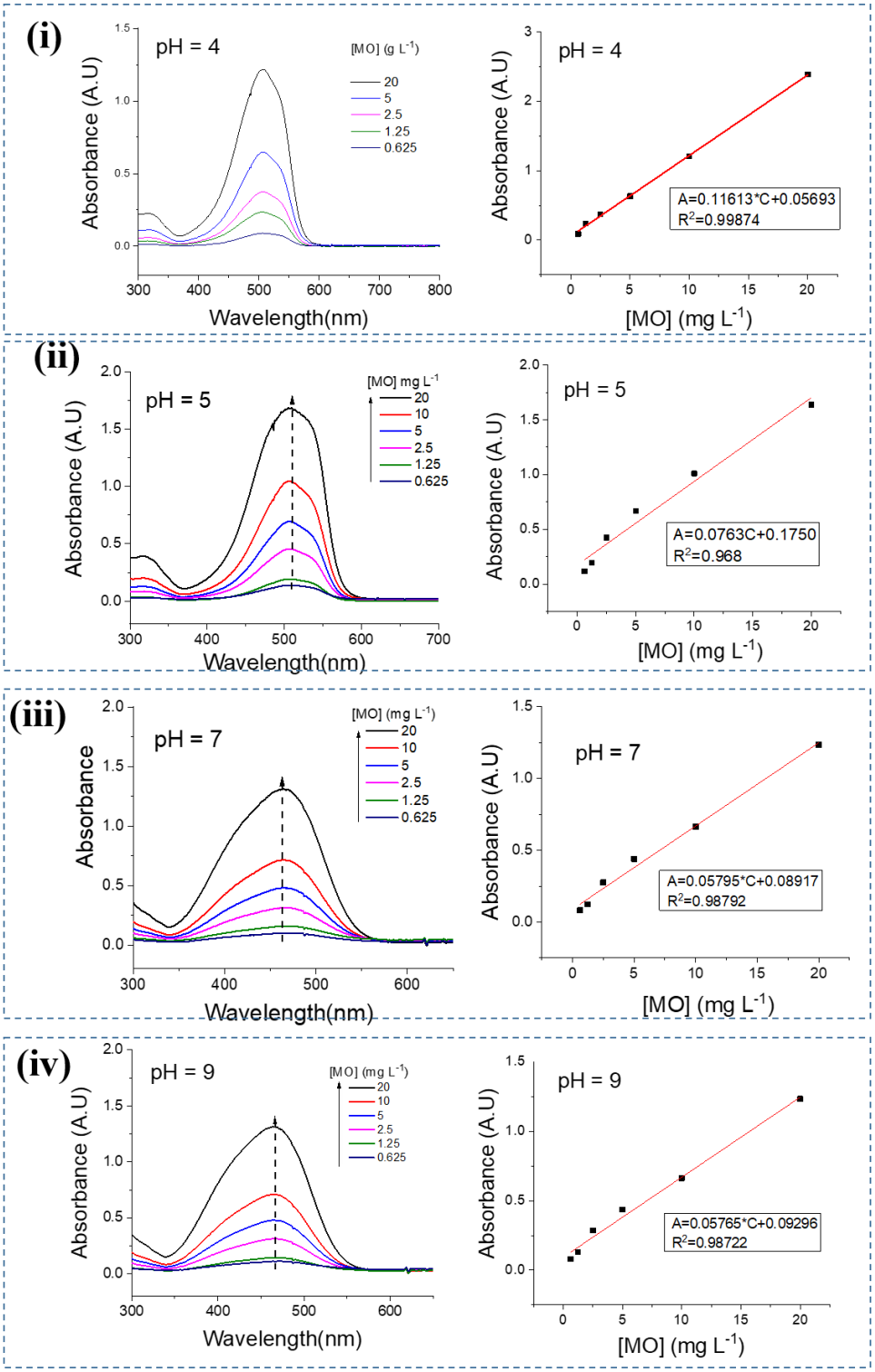


Figure SI.3*. (right) UV-Vis spectra of MO solution at various MO concentrations and (left) corresponding calibration curves for [MO] determination at various pH: (i) pH = 4, (ii) pH = 5, (iii) pH = 7 and (iv) pH = 9*

3. Calibration curve for determine methylene blue (MB) concentration

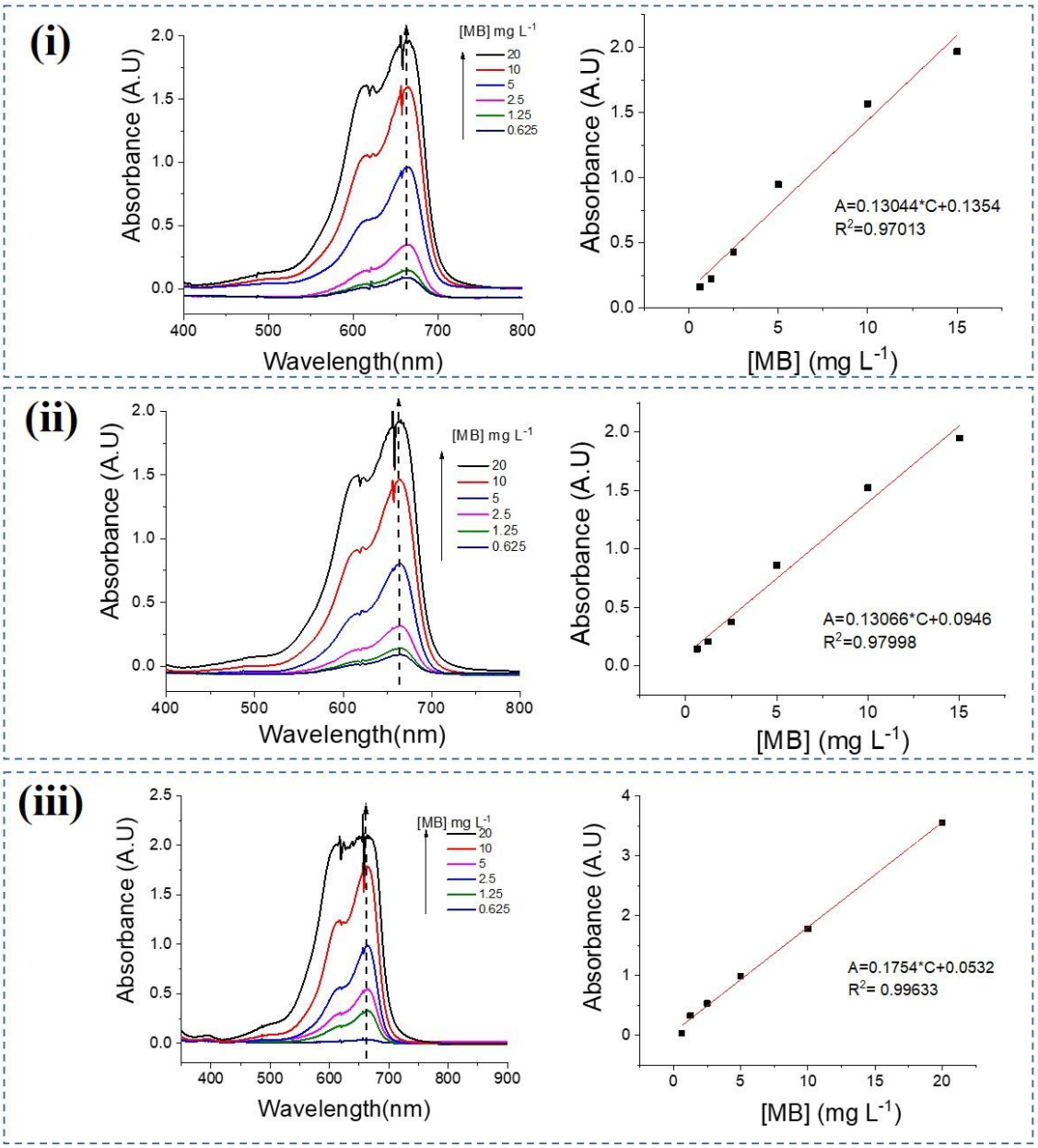


Figure SI.4. *(right) UV-Vis spectra of MB solution at various MB concentrations and (left) corresponding calibration curves for [MB] determination at various pH: (i) pH = 5, (ii) pH = 7 and (iii) pH = 9*

4. Calibration curve for determine congo red (CR) concentration

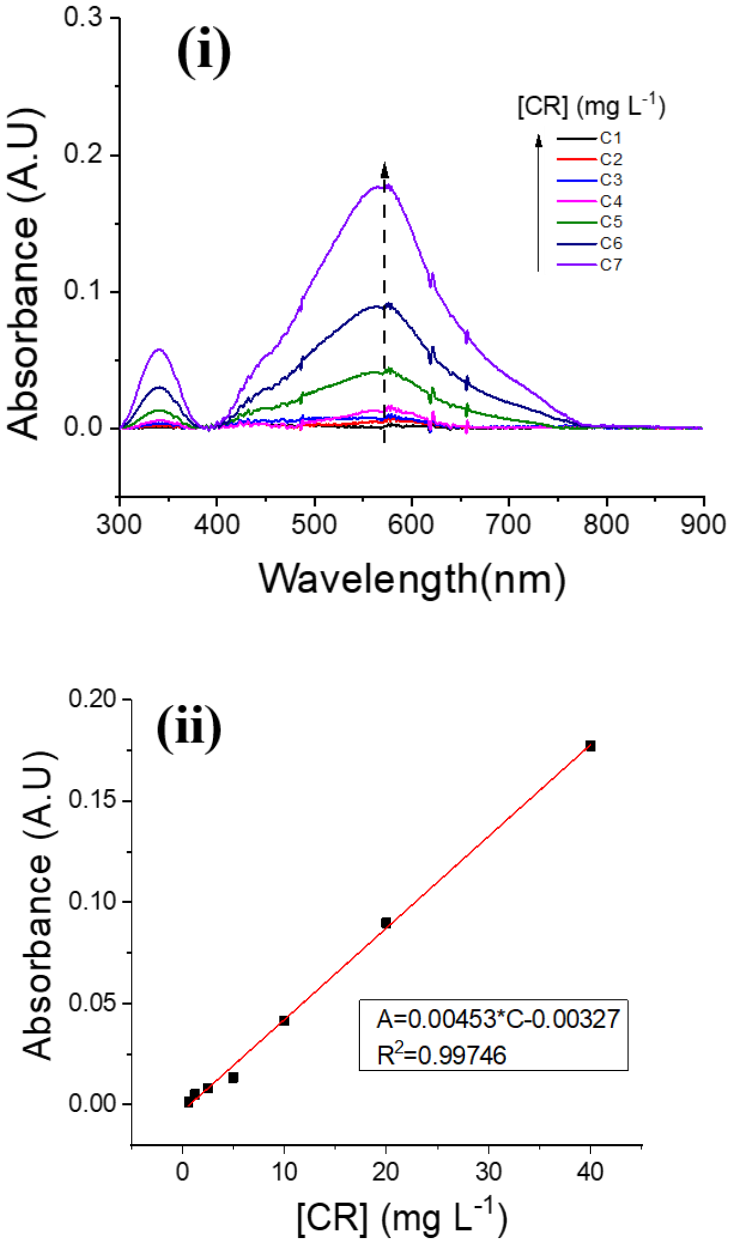


Figure SI.5*. (i) UV-Vis spectra of CR solution at various CR concentrations and (ii) corresponding calibration curves for [CR] determination at pH = 4*

5. Calibration curve for determine moderacid red (RS) concentration

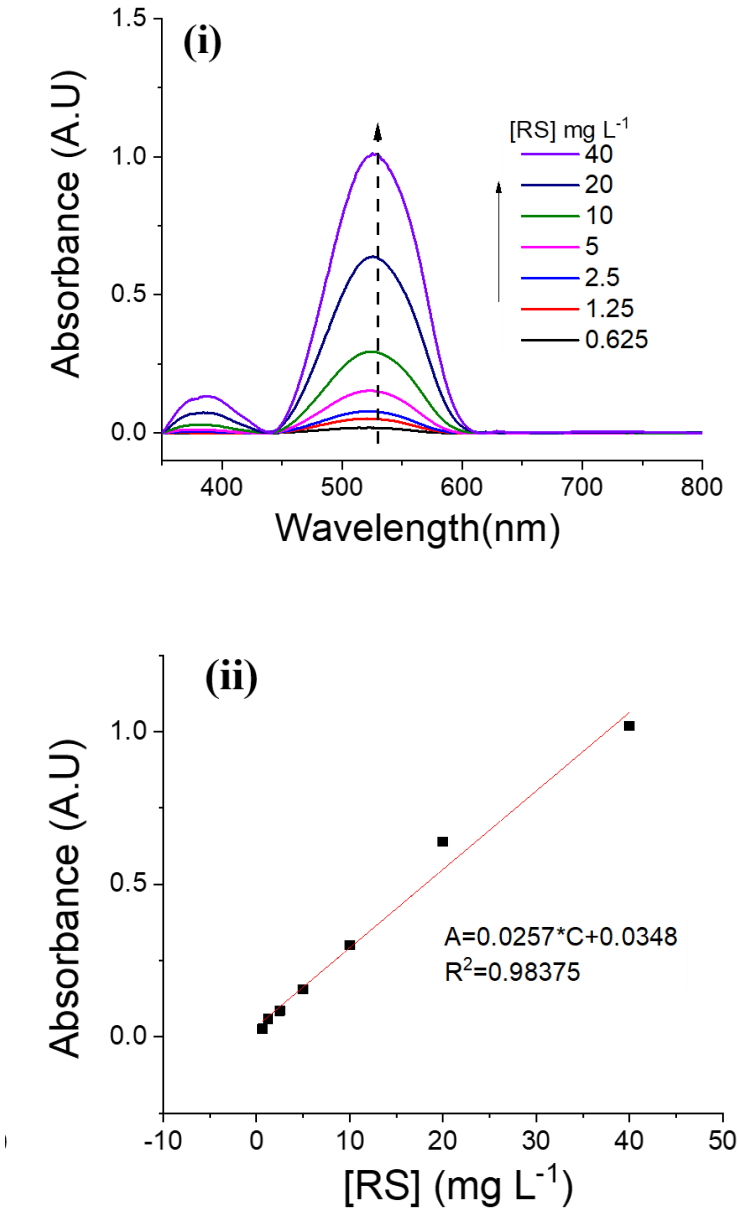


Figure SI.6 *(i) UV-Vis spectra of RS solution at various RS concentrations and (ii) corresponding calibration curves for [CR] determination at pH = 4*

6. Adsorption isotherm according to Langmuir and Freundlich models

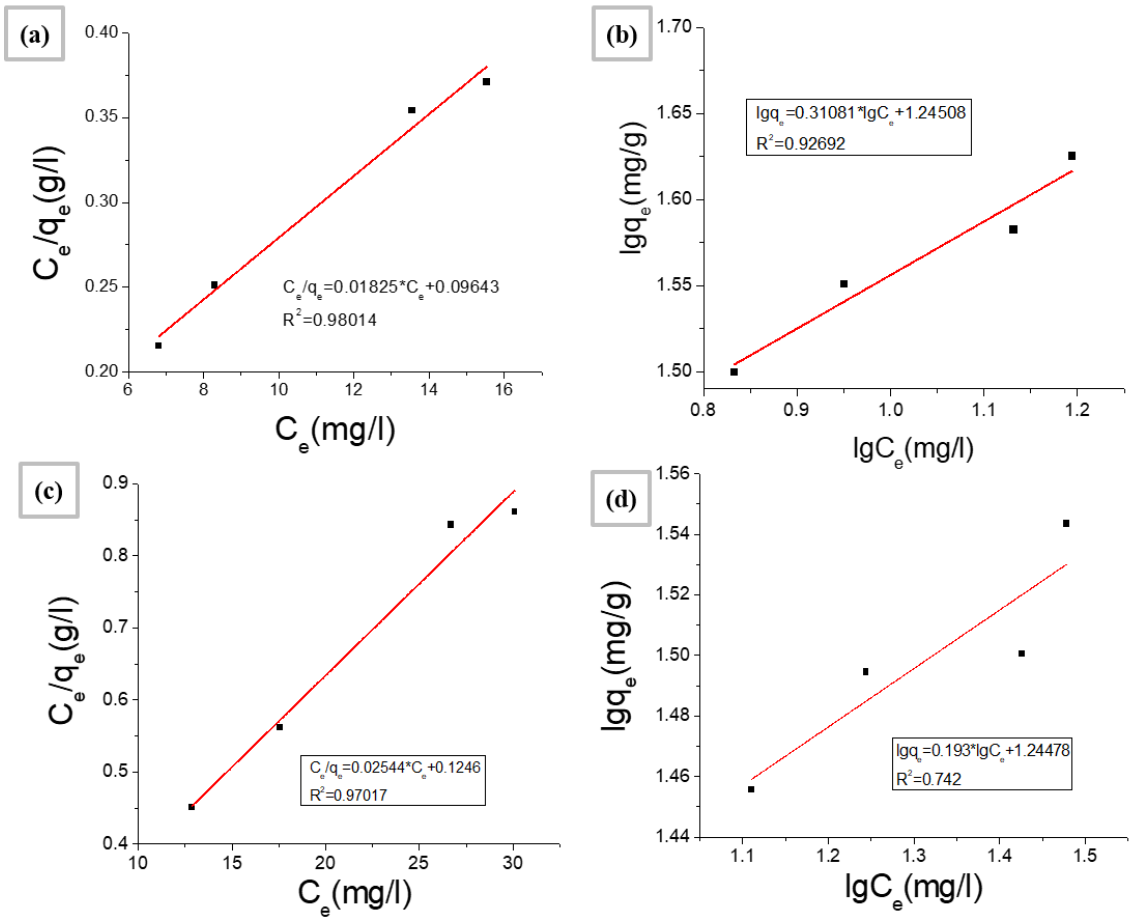


Fig. SI.7. *Adsorption isotherm according to (a, c) Langmuir and (b, d) Freundlich models of MB on (a, b) GFCs/NWPFs and (c, d) bulk GFCs, respectively.*

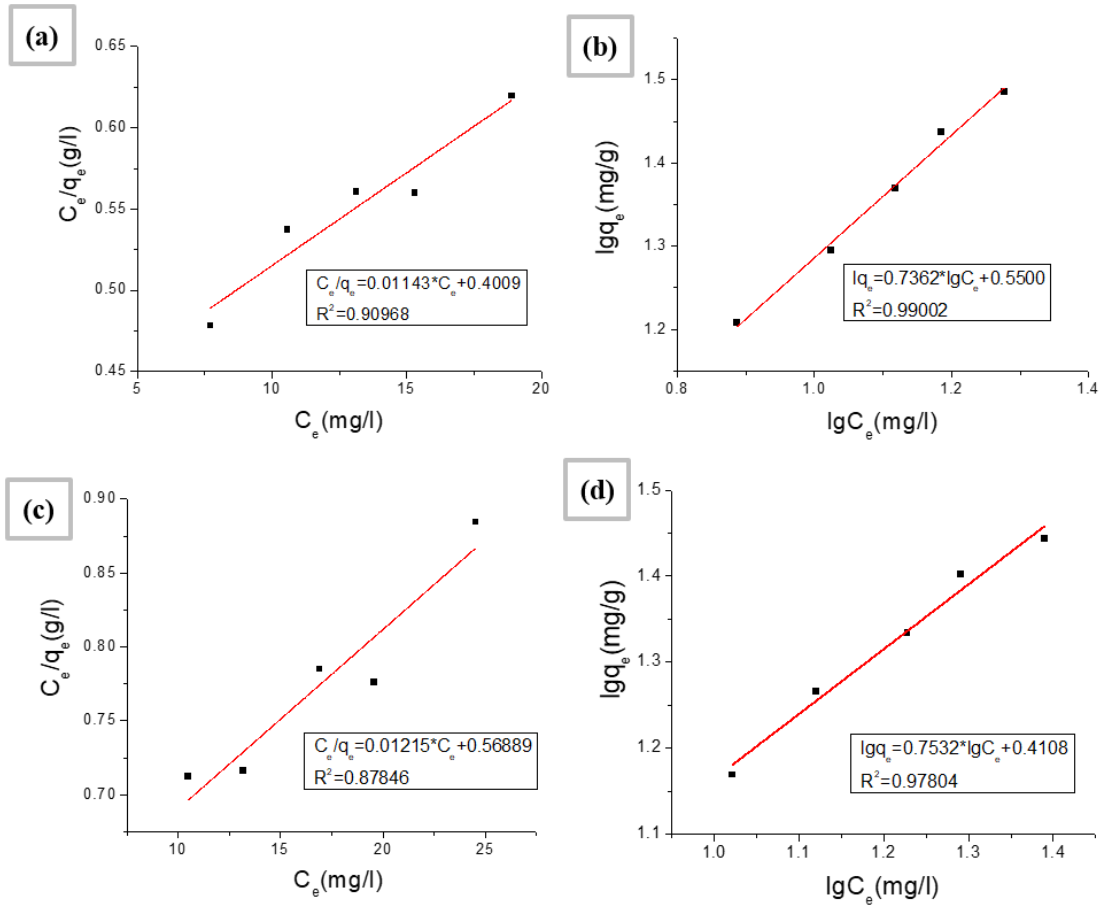


Fig. SI.8. *Adsorption isotherm according to (a, c) Langmuir and (b, d) Freundlich models of MO on (a, b) GFCs/NWPFs and (c, d) bulk GFCs, respectively.*

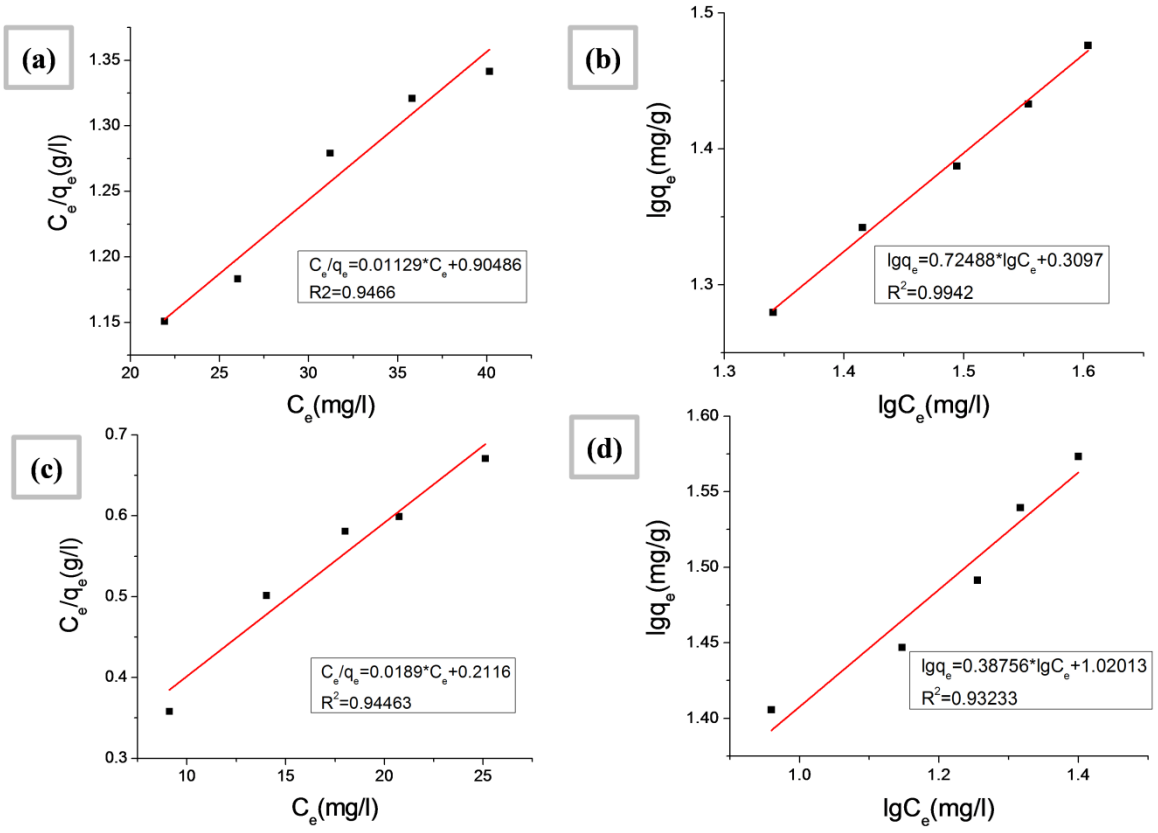


Fig. SI.9. *Adsorption isotherm according to (a, c) Langmuir and (b, d) Freundlich models of CR on (a, b) GFCs/NWPFs and (c, d) bulk GFCs, respectively.*

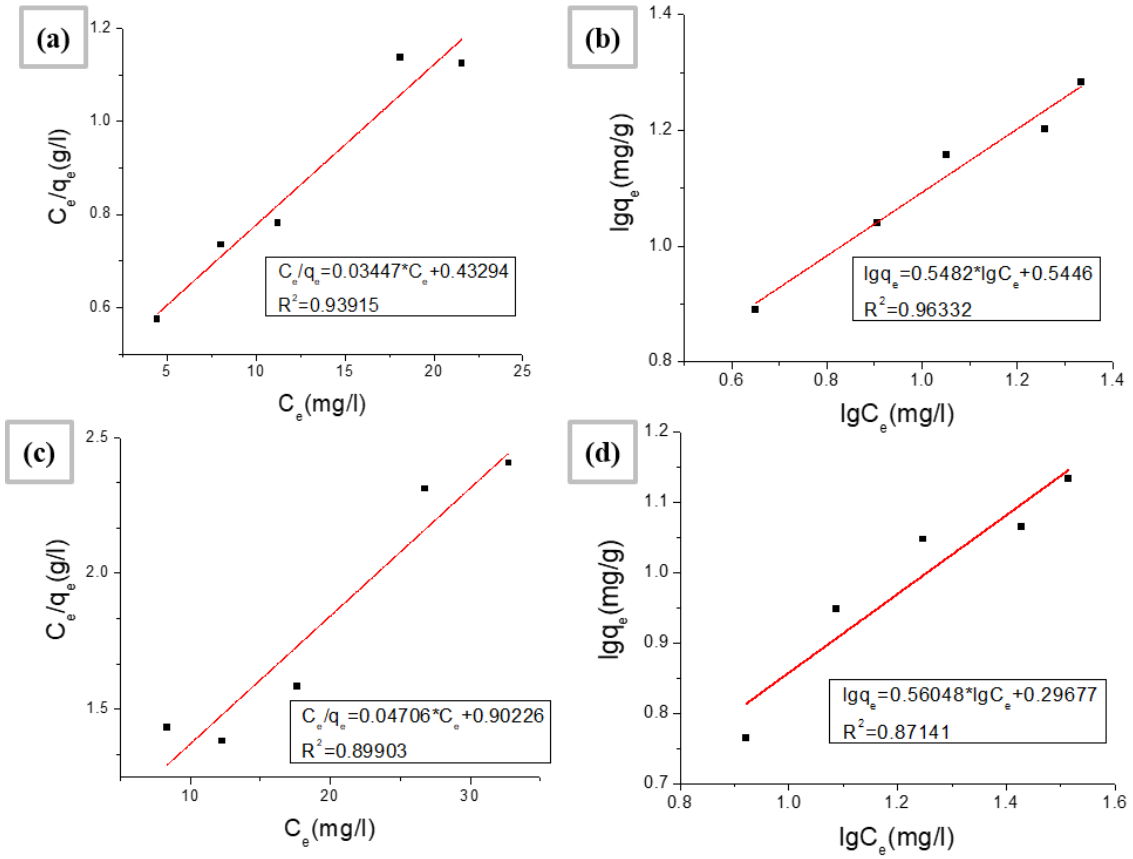


Fig. SI.10. *Adsorption isotherm according to (a, c) Langmuir and (b, d) Freundlich models of RS on (a, b) GFCs/NWPFs and (c, d) bulk GFCs, respectively.*

References

[1] H. V. Tran, L. T. Bui, T. T. Dinh, D. H. Le, C. D. Huynh, A. X. Trinh, Graphene oxide/Fe3O4/chitosan nanocomposite: a recoverable and recyclable adsorbent for organic dyes removal. Application to methylene blue, Materials Research Express, 4 (2017) Article number 035701.

[2] Z. Zhang, J. Kong, Novel magnetic Fe_3O_4@ C nanoparticles as adsorbents for removal of organic dyes from aqueous solution, Journal of Hazardous Materials, 193 (2011) 325-329.

[3] L. Fan, C. Luo, M. Sun, H. Qiu, X. Li, Synthesis of magnetic β-cyclodextrin–chitosan/graphene oxide as nanoadsorbent and its application in dye adsorption and removal, Colloids and Surfaces B: Biointerfaces, 103 (2013) 601-607.

[4] W. Song, B. Gao, X. Xu, L. Xing, S. Han, P. Duan, W. Song, R. Jia, Adsorption–desorption behavior of magnetic amine/Fe3O4 functionalized biopolymer resin towards anionic dyes from wastewater, Bioresource technology, 210 (2016) 123-130.

[5] R. Jiang, Y.-Q. Fu, H.-Y. Zhu, J. Yao, L. Xiao, Removal of methyl orange from aqueous solutions by magnetic maghemite/chitosan nanocomposite films: adsorption kinetics and equilibrium, Journal of Applied Polymer Science, 125 (2012) E540-E549.

[6] M. Hernández-Zamora, F. Martínez-Jerónimo, Congo red dye diversely affects organisms of different trophic levels: a comparative study with microalgae, cladocerans, and zebrafish embryos, Environmental Science and Pollution Research, 26 (2019) 11743-11755.

[7] N. T. Nguyen, N. T. Nguyen, V. A. Nguyen, In Situ Synthesis and Characterization of ZnO/Chitosan Nanocomposite as an Adsorbent for Removal of Congo Red from Aqueous Solution, Advances in Polymer Technology, Volume 2020 (2020) Article ID 3892694.

[8] J. Xu, D. Xu, B. Zhu, B. Cheng, C. Jiang, Adsorptive removal of an anionic dye Congo red by flower-like hierarchical magnesium oxide (MgO)-graphene oxide composite microspheres, Applied Surface Science, 435 (2018) 1136-1142.

[9] W. Zhang, H. Li, X. Kan, L. Dong, H. Yan, Z. Jiang, H. Yang, A. Li, R. Cheng, Adsorption of anionic dyes from aqueous solutions using chemically modified straw, Bioresource Technology, 117 (2012) 40-47.

[10] H. V. Tran, H. V. Nguyen, D. V. Vu, T. D. Le, B. T. Nguyen, D. H. Le, Carbon coated MFe2O4 (M=Fe, Co, Ni) magnetite nanoparticles: A smart adsorbent for direct yellow and moderacid red dyes, Korean Journal of Chemical Engineering, In Press (2021).

[11] Y.-R. Zhang, P. Su, J. Huang, Q.-R. Wang, B.-X. Zhao, A magnetic nanomaterial modified with poly-lysine for efficient removal of anionic dyes from water, Chemical Engineering Journal, 262 (2015) 313-318.

[12] C. Fernández, M. S. Larrechi, M. P. Callao, An analytical overview of processes for removing organic dyes from wastewater effluents, TrAC Trends in Analytical Chemistry, 29 (2010) 1202-1211.