Supplementary Information

Highly porous hydroxyapatite/graphene oxide/chitosan beads as an efficient adsorbent for dyes and heavy metal ions removal

Nguyen Van Hoa[1,*], Nguyen Cong Minh[2], Hoang Ngoc Cuong[3], Pham Anh Dat[1], Pham Viet Nam[4], Pham Hau Thanh Viet[5], Pham Thi Dan Phuong[1], Trang Si Trung[1]

[1] Faculty of Food Technology, Nha Trang University, Vietnam; datpa@ntu.edu.vn (PA Dat); danphuong@ntu.edu.vn (PTD Phuong); trungts@ntu.edu.vn (TS Trung)

[2] Insitute for Biotechnology and Environment, Nha Trang University, Vietnam; minhnc@ntu.edu.vn (NC Minh)

[3] Faculty of Biotechnology, Binh Duong University, Vietnam; hncuong@bdu.edu.vn (HN Cuong)

[4] Faculty of Fishery, Ho Chi Minh City University of Food Industry, Vietnam; nampv.fisheries@gmail.com (PV Nam)

[5] Faculty of Chemistry, Da Lat University, Vietnam; vietpht@dlu.edu.vn (PHT Viet)

* Correspondence: hoanv@ntu.edu.vn (NV Hoa)

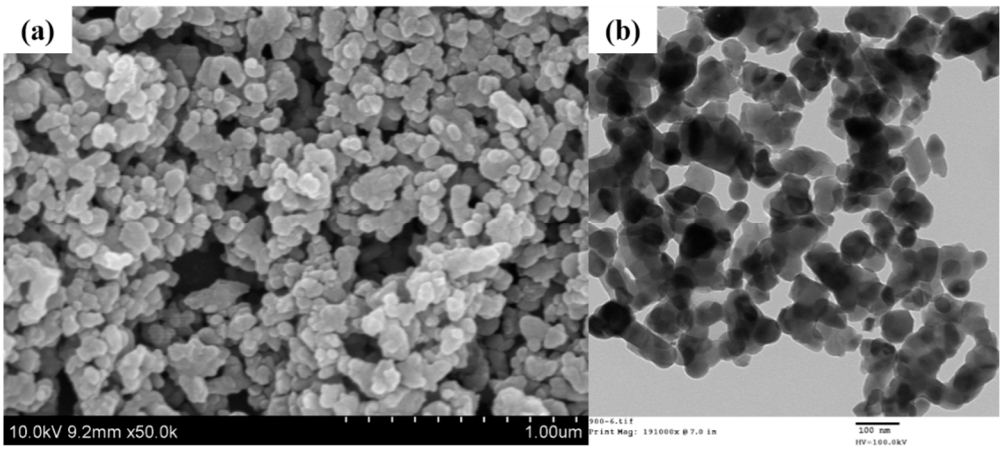

Figure S1. (a) SEM and (b) TEM images of hydroxyapatite.

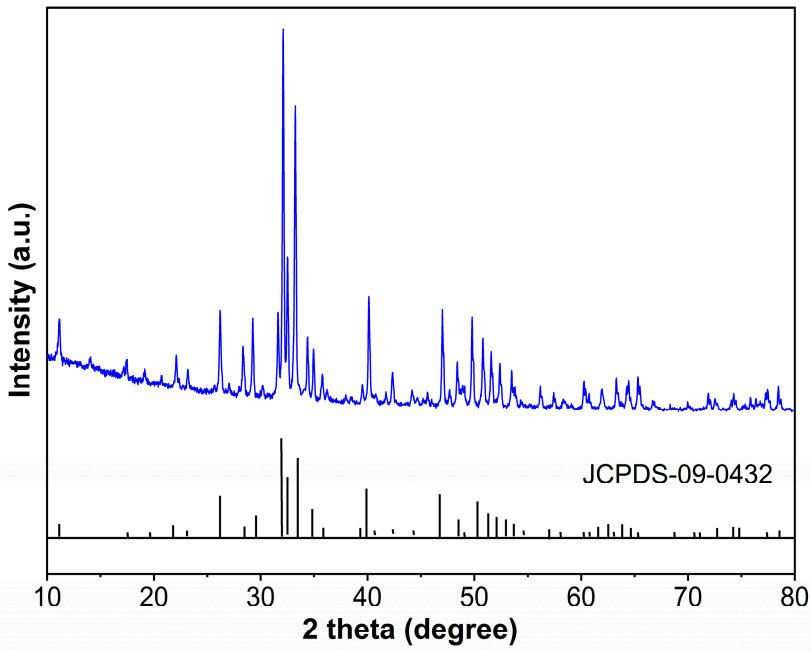

Figure S2. XRD pattern of hydroxyapatite and its JCPDS card No. 09-0432.

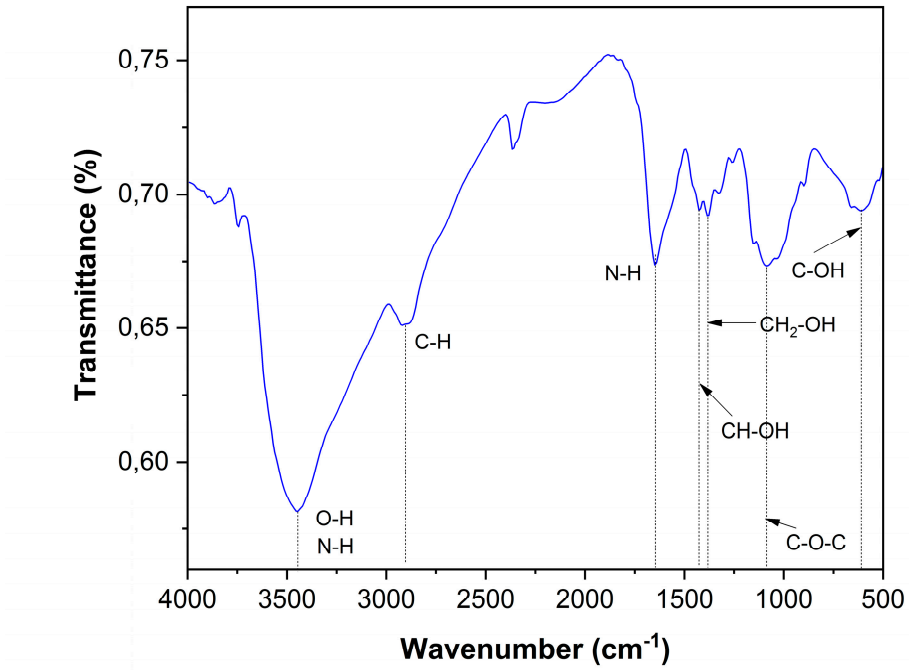

Figure S3. FTIR spectrum of chitosan.

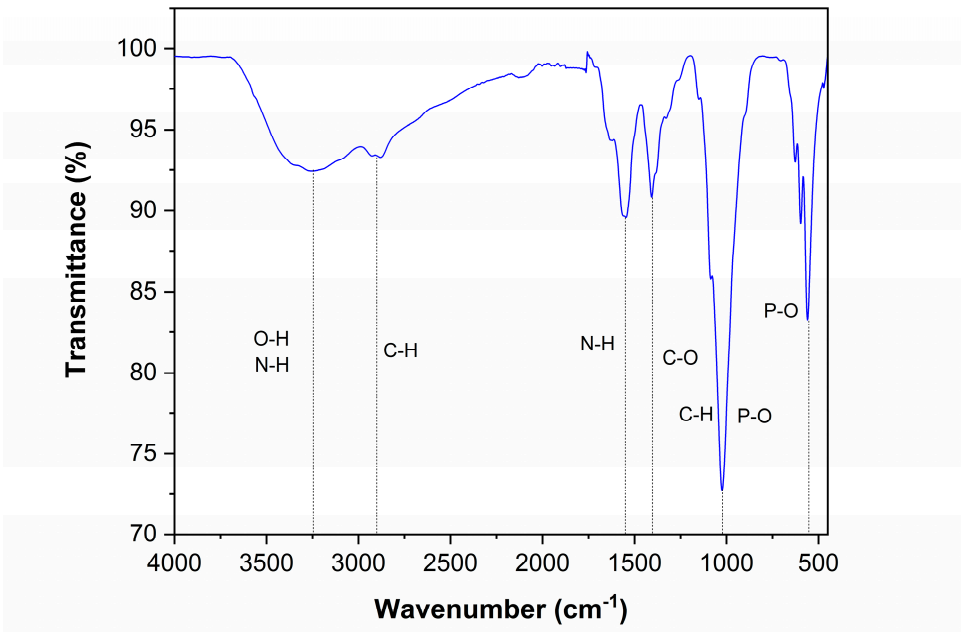

Figure S4. FTIR spectrum of hydroxyapatite.

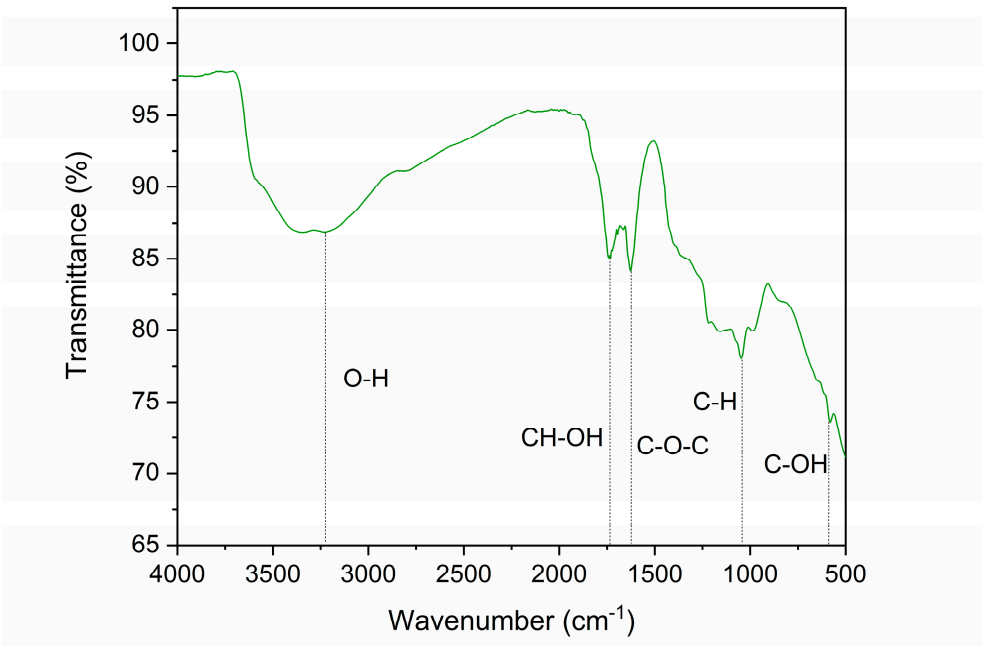

Figure S5. FTIR spectrum of graphene oxide.

Table S1. Maximum adsorption capacity of various chitosan-based materials for MB

Chitosan-based adsorbent	Adsorption capacity ($mg\ g^{-1}$)	Reference
Cross-linked chitosan/sepiolite composite	40.986	[1]
Lignin-chitosan blends	36.25	[2]
H_2SO_4 crosslinked magnetic chitosan nanocomposite beads	20.408	[3]
Chitosan/Fe_3O_4/GO nanocomposite	30.10	[4]
Chitosan-crosslinked $BiFeO_3$/biochar	18.942	[5]
Chitosan–montmorillonite/polyaniline composite	111.00	[6]
Alginate-chitosanmontmorillonite hydrogel beads	137.2	[7]
Crosslinked chitosan/bentonite composite	97.09	[8]
Chitosan/GO/HA beads	99.00	This study

Table S2. Maximum adsorption capacity of various chitosan-based materials for Cu(II) ions

Chitosan-based adsorbent	Adsorption capacity ($mg\ g^{-1}$)	Reference
Magnetic chitosan composite	216.6	[9]
Fe_3O_4-chitosan/EDTA composite	225.0	[10]
Malic acid-enhanced chitosan hydrogel beads	183.8	[11]
ZIF-67 modified bacterial cellulose/chitosan composite aerogel	200.6	[12]
Magnetic bentonite/carboxymethyl chitosan/sodium alginate hydrogel beads	56.79	[13]
Chitosan-pectin gel beads	169.4	[14]
Snail shell/hydroxyapatite/chitosan composite	16.741	[15]
Hydroxyapatite-coated-limestone/chitosan composite	130.75	[16]
Chitosan/GO/HA beads	256.41	This study

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