

# Supporting Documents

*Mohammad Rahat Hossain<sup>1,2</sup>, Taslim Ur Rashid<sup>2,3\*</sup>, Nadira Parvin Lata<sup>1,2</sup>, Shaikat Chandra Dey<sup>2,4</sup>, Mithun Sarker<sup>2</sup> and Sayed Md. Shamsuddin<sup>2\*</sup>*

1 Department of Chemistry, University of Illinois Chicago, Chicago, IL 60607, USA

2 Department of Applied Chemistry and Chemical Engineering, Faculty of Engineering and Technology, University of Dhaka, Dhaka 1000, Bangladesh

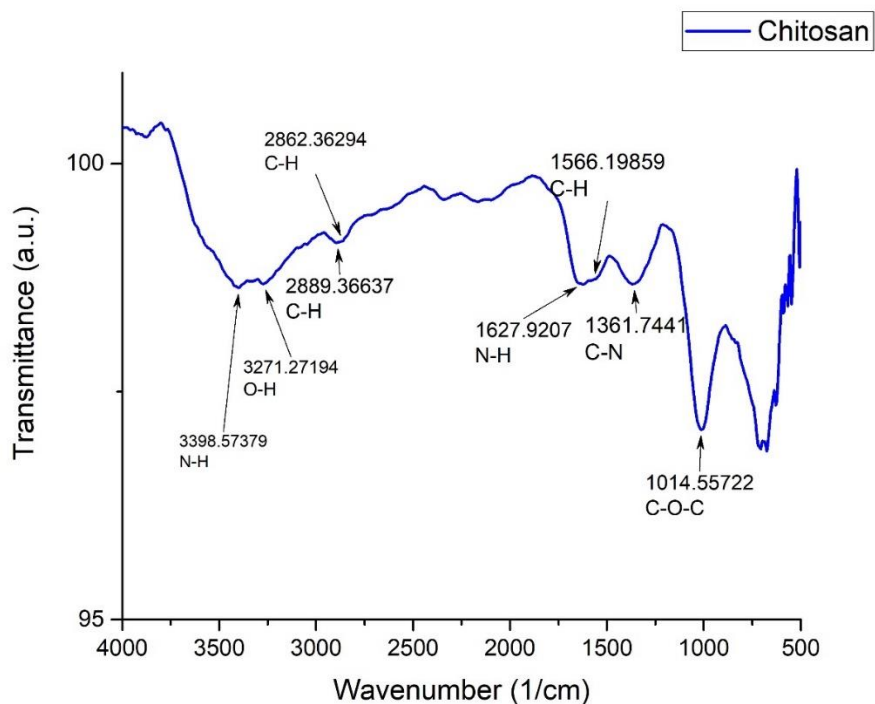
3 Fiber and Polymer Science, North Carolina State University, Raleigh, NC 27695, USA

4 Department of Forest Biomaterials, North Carolina State University, Raleigh, NC 27695, USA

\* Correspondence: [taslim@du.ac.bd](mailto:taslim@du.ac.bd) (T.U.R.); [sdin@du.ac.bd](mailto:sdin@du.ac.bd) (S.M.S.)

## 1. Fourier Transform Infrared (FT-IR) analysis

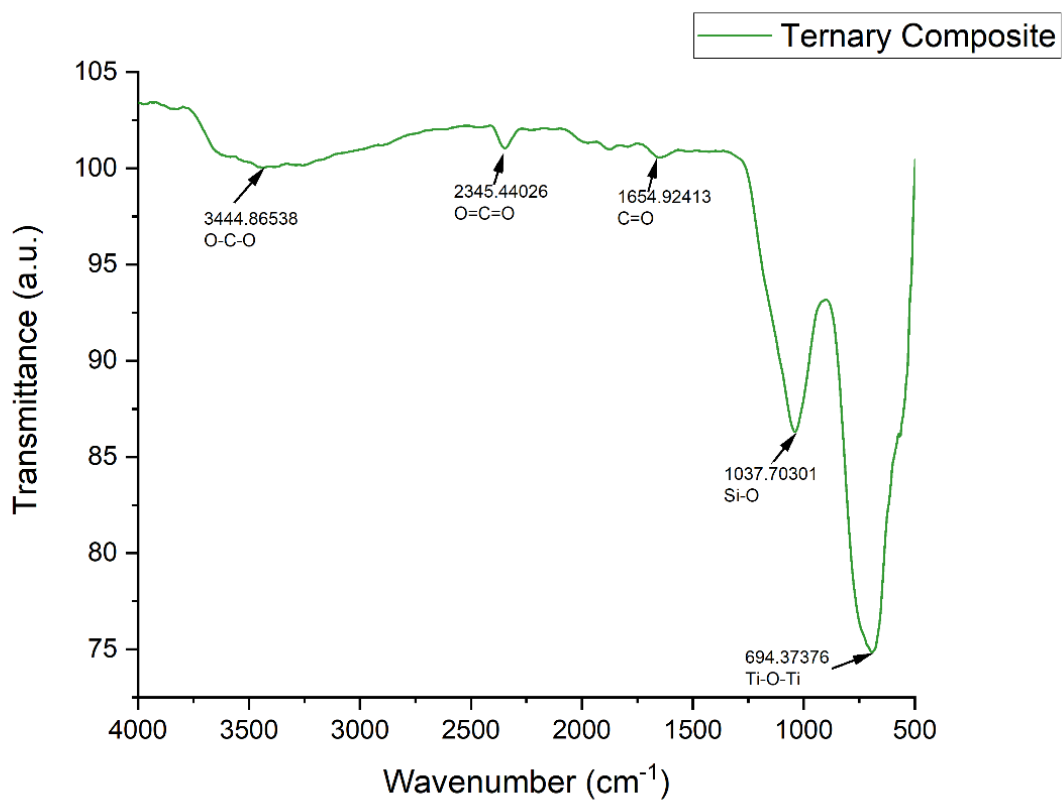
The FT-IR spectrum of chitosan (**Figure S1**) showed the characteristic peak at  $3398\text{ cm}^{-1}$  and  $3271\text{ cm}^{-1}$ . These peaks are assigned to O–H stretching vibration of water and hydroxyls overlapped with N–H stretching vibration of free amines [1,2]. Adsorption band at  $1627\text{ cm}^{-1}$  is related to in plane N–H scissoring and bending from the primary amine of Chitosan polysaccharide [3,4].



**Figure S1.** FT-IR spectra of chitosan.

Both of these functional groups (O–H, N–H) on chitosan chains can serve as coordination and reaction sites for the adsorption of transition metals and organic species [5]. Absorption peak at  $1014\text{ cm}^{-1}$  is related to the stretching vibrations of C–O–C groups [4] and  $1361\text{ cm}^{-1}$  is attributed to C–N stretching vibrations of amine or amide functional groups from chitosan [5]. The bending vibrations of C–H bond in  $-\text{CH}_2-$  and  $-\text{CH}_3$  groups are located at  $1566\text{ cm}^{-1}$  [4] and C–H symmetric and asymmetric vibrations are located at  $2889\text{ cm}^{-1}$  and  $2862\text{ cm}^{-1}$  [3,4].

In the spectrum of ternary composite (**Figure S2**), in the region  $700\text{--}500\text{ cm}^{-1}$ ,  $\text{TiO}_2$  revealed an intense peak. This peak is assigned to the characteristic peak of  $\text{TiO}_2$  i.e. stretching vibrations of Ti–O–Ti bonds at  $694\text{ cm}^{-1}$  [4,5]. Absorption band at  $2345\text{ cm}^{-1}$  is related to the stretching vibrations of  $\text{CO}_2$  and band at  $1037\text{ cm}^{-1}$  is related to the bending vibrations of Si–O bonds, representing the kaolinite component [6].



**Figure S2.** FT-IR spectra of Ternary composite.

## References

1. Nithya, A.; Jothivenkatachalam, K. Visible light assisted TiO<sub>2</sub>-chitosan composite for removal of reactive dye. *J. Environ. Nanotechnol* **2014**, 3, 20-26.

2. Rashid, T.U.; Rahman, M.M.; Kabir, S.; Shamsuddin, S.M.; Khan, M.A. A new approach for the preparation of chitosan from  $\gamma$ -irradiation of prawn shell: effects of radiation on the characteristics of chitosan. *Polymer International* **2012**, *61*, 1302-1308.
3. Dey, S.C.; Al-Amin, M.; Rashid, T.U.; Sultan, M.Z.; Ashaduzzaman, M.; Sarker, M.; Shamsuddin, S.M. Preparation, characterization and performance evaluation of chitosan as an adsorbent for remazol red. *International Journal of Latest Research in Engineering and Technology* **2016**, *2*, 52-62.
4. Saravanan, R.; Aviles, J.; Gracia, F.; Mosquera, E.; Gupta, V.K. Crystallinity and lowering band gap induced visible light photocatalytic activity of TiO<sub>2</sub>/CS (Chitosan) nanocomposites. *International journal of biological macromolecules* **2018**, *109*, 1239-1245.
5. Zainal, Z.; Hui, L.K.; Hussein, M.Z.; Abdullah, A.H. Characterization of TiO<sub>2</sub>-chitosan/glass photocatalyst for the removal of a monoazo dye via photodegradation-adsorption process. *Journal of hazardous materials* **2009**, *164*, 138-145.
6. Wang, C.; Shi, H.; Zhang, P.; Li, Y. Synthesis and characterization of kaolinite/TiO<sub>2</sub> nano-photocatalysts. *Applied Clay Science* **2011**, *53*, 646-649.