Core-shell Graphene Oxide/Carboxy Methyl Cellulose-Vortex Ring Particles for the Adsorptive Removal on Contrasting Azo Dyes

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Abstract

The toxic dyes containing wastewater generated from various industries, is a serious environmental concern today with purification challenges. Recently, graphene-based functional nanomaterials scrutinized to be an efficient candidate for the remediation of dye. In this study, graphene oxide/carboxy methyl cellulose-vortex ring aerogels (GO/CMC-VRAs) were synthesised, followed by a freeze-drying process for the adsorptive removal of contrasting model dye, methylene blue (MB) and methyl orange (MO). Various key factors affecting the adsorption process, including pH, adsorbent dose, shapes vortex ring aerogel, GO/CMC-VR aerogel and hydrogel, contact time, and initial dye concentration, are optimized and investigated. The optimum value of pH for MB and MO adsorption are found to be 10 and 6 respectively and the absorbent dose is 0.1 mg (5 particles). The adsorption capacity of GO/CMC-VRA for MB and MO are 1022 mg/g and 960 mg/g respectively at 24 h, while GO-VRA exhibited a capacity of 967 mg/g and 639 mg/g. The pseudo-second order kinetic adsorption model is well-fitted for both adsorbents and dyes. The outstanding adsorption mechanism of MB and MO onto the GO/CMC-VRA was mainly by electrostatic interactions, that confirmed with the pseudo-second-order kinetic model. Superbly, the developed attractive composites can be simply regenerated and reused in adsorption-desorption cycles, which could obtain around 981 mg/g of GO/CMC-VRA and 927 mg/g of GO-VRA after 5-time recycling. Therefore, GO/CMC-VRA composite would be a promising adsorbent for the remediation of dyes from wastewater.

References

[1] Shao, Y., et al., Journal of Molecular Liquids, 375 (2023): p.121341
[2] An, D., et at., Nature communications, 7 (2016): p. 12401

Figures

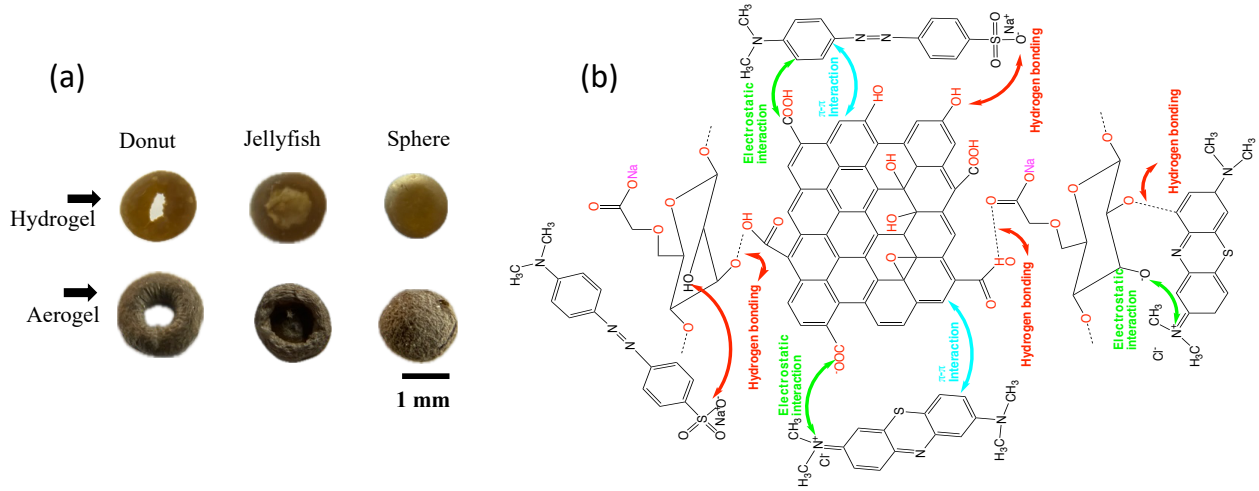

Figure 1: (a) Optical image of GO/CMC-VR particle both in hydrogel and aerogel forms (b)Possible interaction and adsorption mechanism of MB and MO on the GO/CMC-VR particles