Adsorptive Removal of Antibiotics-Tetracycline Using Graphene Oxide-Vortex Ring Aerogels

Bashirunnisa Ananya [a, b]
Md. Israil Hossain [a, b], Maria Iliut [a, b], Aravind Vijayaraghavan [a, b],
[a] *Department of Materials, The University of Manchester, Manchester M13 9PL, UK*
[b] *National Graphene Institute, The University of Manchester, Manchester M13 9PL, UK*
Contact@E-mail: bashirunnisa.ananya@postgrad.manchester.ac.uk

Abstract

Pharmaceutical pollutants like antibiotics are commonly found in water bodies due to their extensive use and the inefficiency of conventional water treatment. These chronic contaminants degrade the water quality and pose serious risks to both human and environmental health. Antibiotics are especially concerning, as their accumulation accelerates the spread of antibiotic-resistant bacteria (ARB), a major global health threat. This study uses graphene oxide-vortex ring (GO-VR) aerogels as a high-performance, reusable adsorbent to remove tetracycline, a model antibiotic, from water. The GO-VR aerogel particles are synthesised through the self-assembly of graphene oxide (GO) in a cationic cetyltrimethylammonium bromide (CTAB) medium, followed by a freeze-drying process. Based on the different parameters like GO and CTAB solution concentration and impact velocity, various shapes of GOVR particles are derived, such as sphere, donut, and jellyfish. The synthesised particles are characterised using scanning electron microscopy (SEM), UV-Vis spectroscopy, and Fourier-transform infrared spectroscopy (FTIR), which confirms the aerogel particles' porous structure and abundant surface functional groups. Adsorption experiments are performed under different conditions, such as pH, adsorbent dosage, contact time, and temperature. The results demonstrate that the GO-VR particle reveals a high adsorption capacity for tetracycline with multiple adsorption-desorption cycles. This study presents an innovative graphene oxide-based core-shell structure and highlights the potential of 2D materials for sustainable water treatment applications.

References

[1] Shao, Y., et al., Journal of Molecular Liquids, 375 (2023): p. 121341
[2] Thakur, S., et al., Chemosphere, 352 (2024): p. 141483
[3] Liang, Z., et al., Water Reuse, 13 (2023): p. 220-232

Figures

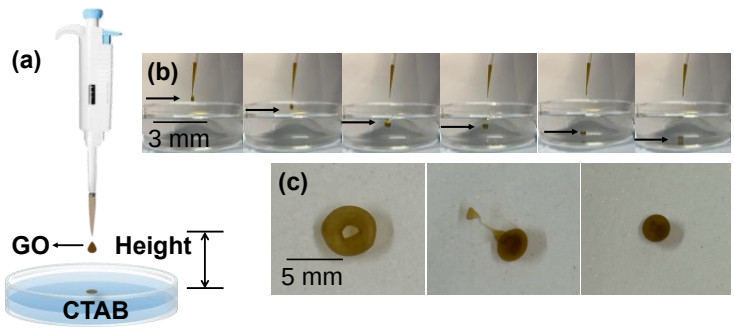

Figure 1: GO-VR formation diagrams (a) Schematic illustration of the GO-VR particle fabrication set-up. (b)High-speed photographic images of a GO droplet penetrating CTAB solution and the formation of a vortex ring. (c) Photographic images of GO-VR in three different shapes-donut, jellyfish, and sphere.