Synthesis and Characterization of Graphene oxide Polydopamine Aerogels for Contaminant Removal in Water

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Background

- Graphene, a two dimensional nanomaterial, emerged as a highly efficient adsorbent for removing contaminants from water and wastewater
- Graphene needs to be assembled into architecturally controllable monolithic structures to:
  - Incorporate into functional water treatment devices
  - Resist release of graphene into treated water

Objective

- Utilize bio-inspired polymer (polydopamine) modified graphene to synthesize monolithic aerogels with controllable architecture using 3D printed mold
- Characterize physiochemical properties of the synthesized graphene oxide-polydopamine (GO-PDA) aerogel
- Evaluate the removal capacity for a range of contaminants

Method

- Freeze casting with 3D printed molds
  - GO-PDA Ink
  - 3D printed molds
- PDA helps to provide structural integrity to the aerogel

Contaminant Removal

- Dye Removal: Methylene Blue (MB) - Cationic Dye
  - Removal Capacity
  - Removal Kinetics
  - Highest Removal Capacity 57.29 mg/g
- Heavy Metal Removal: Hexavalent Chromium (Cr (VI))
  - Removal Capacity
  - Removal Kinetics
  - Highest Removal Capacity 33.13 mg/g

Characterization

- Scanning Electron Microscope Image
  - Graphene Oxide
  - Graphene Polymer Aerogel
  - More porous network in graphene polymer aerogel
- X-Ray Diffraction Spectroscopy
- Raman Spectroscopy
  - Confirms chemical bond between graphene and PDA
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Evans Blue (EB) - Anionic Dye
- Removal Capacity
- Removal Kinetics
- Highest Removal Capacity 40.96 mg/g

Recycling of Aerogel for MB Removal
- Desorption: Ethanol (pH 2) solution for 24 hr
- Recycling and reuse experiment for GO-PDA Aerogel with initial MB concentration of 25 mg/L
- High recycling performance up to 3 cycles

Heavy Metal Removal:
- Hexavalent Chromium (Cr (VI))
- Removal Capacity
- Removal Kinetics
- Highest Removal Capacity 33.13 mg/g

Future Work

- 3D printed molds can be utilized to synthesize graphene based aerogel with architectural flexibility
- Polydopamine can provide structural integrity to the freeze casted graphene based aerogels
- Synthesized GO-PDA aerogel exhibited high and fast contaminant (dyes and heavy metals) removal

References


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