Using modified Graphene Oxide to absorb radioactive wastes

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Abstract

Radioactive waste management remains a critical challenge in the nuclear industry, particularly due to the long-term risks posed by isotopes such as cesium. This study investigates the adsorption capacity of graphene oxide (GO) for cesium ions (Cs^+), using Cs-133 as a stable isotope model. The research emphasizes the role of oxygen-containing functional groups (carboxyl, hydroxyl, epoxy, carbonyl) and defect sites in facilitating cesium binding, with adsorption governed mainly by ion exchange and electrostatic interactions. Two reduction strategies—solvothermal reduction with ethylene glycol and a one-step annealing method using ethanol—were employed to synthesize Cs-loaded reduced graphene oxide (Cs/rGO). Characterization was conducted using SEM, TEM, EDX, Raman, and XRD techniques. Results confirmed Cs incorporation onto rGO surfaces, supported by elemental mapping (Fig. 1) and contrast variations in TEM (Fig. 2) due to Cs' high atomic number. Reduction decreased oxygen content but retained sufficient functional groups for sorption. Overall, the findings demonstrate that GO and rGO hold strong promise as sustainable sorbents for the removal of radioactive Cs, offering an environmentally viable approach for nuclear waste treatment.

References

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Figures

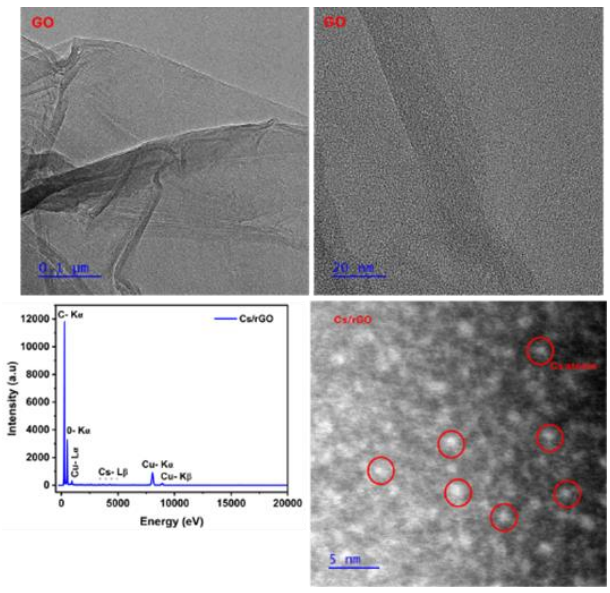

Figure 1: (a) and (b) show GO at different resolutions, compared to (d) which presents the Cs/rGO sample; (c) displays the elemental spectra of the Cs/rGO sample. (Modified Solvothermal method)

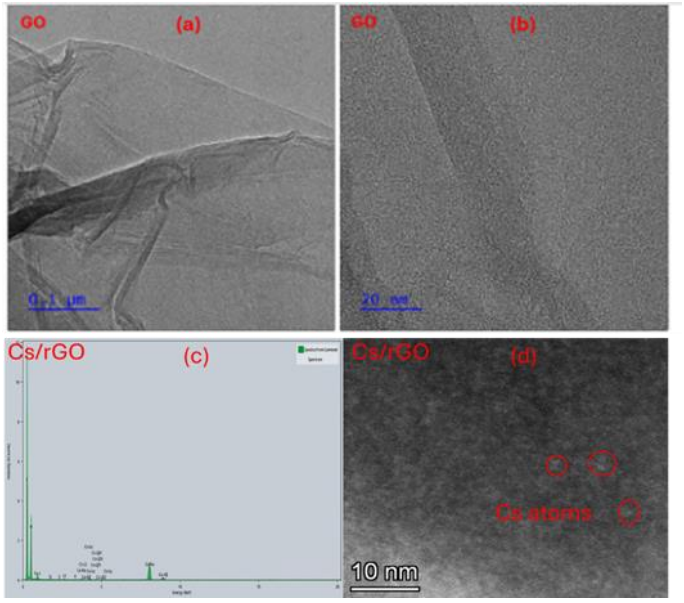

Figure 2: (a) and (b) show GO at different resolutions, compared to (d) which presents the Cs/rGO sample; (c) displays the elemental spectra of the Cs/rGO sample. (one-step annealing method)