**ABSTRACT**

The development of graphene-based material for multifunctional properties is vital in environmental applications. Herein, the dual functional properties of magnetite decorated reduced graphene oxide (rGO/Fe3O4) nanocomposite are explored, and its mechanism is systematically investigated. The rGO/Fe3O4 prepared by the solvothermal method is subjected to transmission electron microscopy and X-ray diffraction which confirms the successful formation of the nanocomposite. The superior performance of the antibacterial activity towards *Escherichia coli* and removal of Pb (II) toxic substances by rGO/Fe3O4 aqueous suspension are explained. The incubation of bacterial cells with rGO/Fe3O4 nanocomposite shows maximum cell lysis with minimum dosage and incubation time. The investigation of independent in vitro biological assay results reveals that bactericidal action of rGO/Fe3O4 composite is mainly caused by reactive oxygen species (ROS) dependent oxidative stress. Furthermore, the adsorption capacity of organic metal ion Pb (II) is evaluated, and the adsorption isotherms are fitted with the Freundlich model with a maximum adsorption capacity of 76.3 mg g−1. The results obtained in this study demonstrates that the multifunctional properties such as superior killing of gram-negative pathogenic species followed by effective removal of Pb (II) make the nanocomposite an ideal biological and chemical disinfectant agent for future wastewater management.