

## One-off Separation of Multiple Types of Oil-In-Water Emulsions With Surface-Engineered Graphene-Based Multilevel Structure Materials

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**Abstract :** In the process of treating industrial oily wastewater with complex components, the traditional treatment methods (flotation, coagulation, microwave heating, etc.) often produce high operating costs, secondary pollution, and other problems. In order to solve these problems, the materials with high flux and stability applied to surfactant-stabilized emulsions separation have gained huge attention in the treatment of oily wastewater. Nevertheless, four stable oil-in-water emulsions can be formed due to different surfactants (surfactant-free, anionic surfactant, cationic surfactant, and non-ionic surfactant), and the previous advanced materials can only separate one or several of them, cannot effectively separate in one step. Herein, a facile synthesis method of graphene-based multilevel filter materials (GMFM) which can efficiently separate the oil-in-water emulsions stabilized with different surfactants only through its gravity. The prepared materials with high stability of 20 cycles show a high flux of  $\sim 5000 \text{ L m}^{-2} \text{ h}^{-1}$  with a high separation efficiency of  $> 99.9\%$ . GMFM can effectively separate the emulsion stabilized by mixed surfactants and oily wastewater from factories. The results indicate that the GMFM have a wide range of applications in oil-in-water emulsions separation in industry and environmental science.

**Keywords :** emulsion, filtration, graphene, one-step

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