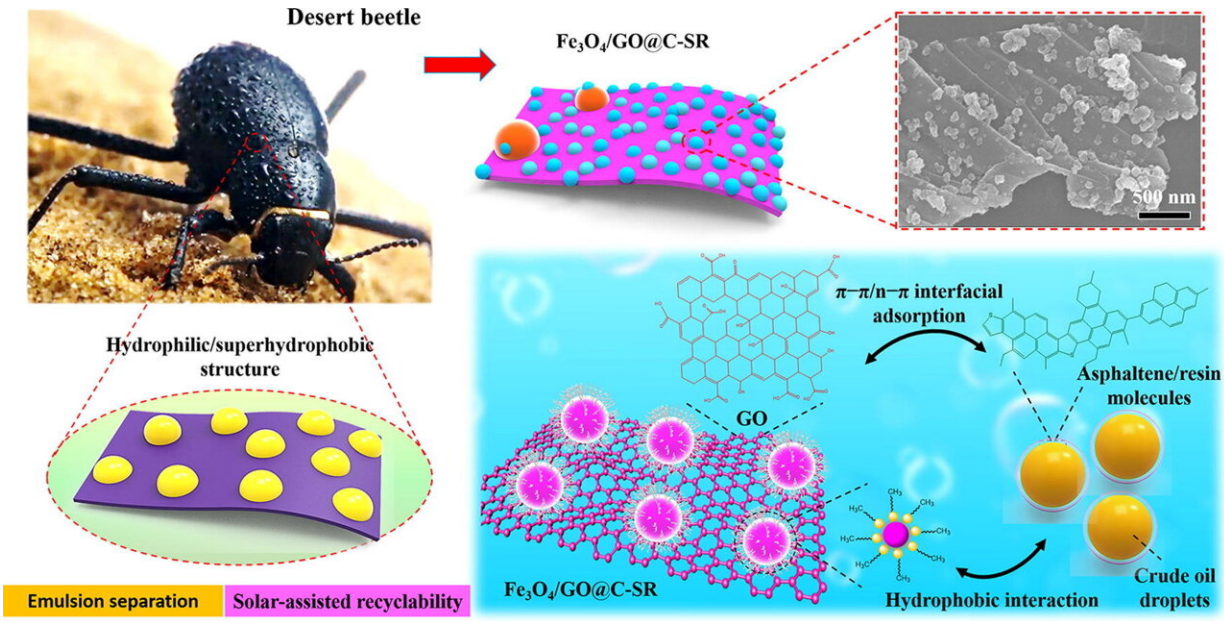
Desert-beetle-inspired magnetic demulsifier developed with excellent oil-in-water emulsion separation performance

September 16 2021, by Liu Jia



Graphical abstract. Credit: DOI: 10.1016/j.cej.2021.130904

Prof. Zeng Zhixiang's team at the Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences (CAS) developed a novel magnetic demulsifier with desert beetle-inspired microstructures, realizing high-efficiency oil-in-water emulsion separation with low recovery energy consumption. The study was published in Chemical Engineering Journal.

In recent years, oily wastewater discharge and marine oil spills have led to certain oily water pollution, posing great threats to the global marine ecosystem and human health. However, existing materials for oily wastewater treatment, especially superwetting particles, exhibit inferior separation efficiency and high recovery energy consumption, thus seriously limiting their practical application in oil-in-water emulsion separation.

Inspired reversely by the hydrophilic/superhydrophobic structure on the Stenocara beetle's back for water collection and water retention, researchers at NIMTE fabricated a magnetic graphene oxide-based composite (Fe_3O_4/GO@C-SR) with desert beetle-like microstructure, which consists of underwater superoleophobic underlayer and superhydrophobic/superoleophilic bumps.

By virtue of a facile one-step solvothermal method, the magnetically active graphene oxide (Fe_3O_4/GO) particles were synthesized. Then the superhydrophobic/superoleophilic carbon black particles (C-SR) were assembled on the surface of Fe_3O_4/GO particles to construct a beetle-like structure via a ball milling technique.

The synthesized Fe_3O_4/GO@C-SR demulsifier showed high hydrophobicity/oleophilicity in air and high oleophobicity under water. The superoleophilic bumps, i.e., C-SR, can capture and aggregate tiny oil droplets, and the hydration layer formed in the hydrophilic region can effectively prevent the captured oil droplets from spreading on the composite structure, thus enhancing the oil-in-water emulsion separation efficiency.

In addition, compared with traditional magnetic GO demulsifiers, the synthesized magnetic Fe_3O_4/GO@C-SR demulsifier showed higher photothermal conversion efficiency and superior recyclability, thus reducing the energy consumption of the demulsifier in the recovery

process.

More information: Yong Xu et al, Desert beetle-like microstructures bridged by magnetic Fe_3O_4 grains for enhancing oil-in-water emulsion separation performance and solar-assisted recyclability of graphene oxide, *Chemical Engineering Journal* (2021). DOI: 10.1016/j.cej.2021.130904

Provided by Chinese Academy of Sciences