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Superhydrophobic carbon nanomaterials coated melamine sponges and their application as fluid channel for continuous separation of oils and organic solvents from water

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Abstract:
Oil spill accidents have urged scientists across the world to develop an immediate cleanup technology because the spilled oil significantly affects the ecological and environmental system. Superhydrophobic and superoleophilic materials have shown potential application in the field of oil spill cleanup due to their outstanding absorption capabilities, high selectivity, chemical inertness and excellent recyclability. In this regard, carbon-based absorbents have been considered to be the best candidates as they possess high surface area, low density, excellent mechanical properties, good chemical stability, environmental friendliness and large pore volume. In my research work, carbon nanomaterials and their composites were synthesized for the application of oil-water separation.

Introduction:

- In a massive oil spill accident in the **Gulf of Mexico in 2010**, approximately **4.9 million barrels of oil spilled**.
- This accident mostly impacted **marine species and seagrasses**.
- Out of **322 species**, **53 species** were threatened and **29** were nearly threatened, including **16 species** of **sharks** and **eight corals**.
- In July 2015, on the beach of Kinmen County of Fujian province, a large black viscous oil patch was found with a total length of approximately one kilometer.
- The cleanup operations of oil spill greatly reduce the environmental loss and highly improve the economic resources of that area.

Fig.1. Spilled oil pollute on the beach of Kinmen county, Fujian province. Adopted with permission from Apple Daily

(A) Carbon materials as oil sorbents:

In this work, the synthesis, applications and reusability of carbon-based absorbents such as carbon aerogels, graphene or carbon nanotubes (CNTs) coated sponges, carbon nanotube forests, graphene foams or sponges, carbon coatings, activated carbon, porous carbon nanoparticles and carbon fibers have been reviewed and their performances compared.

(B) Superhydrophobic carbon nanomaterials coated melamine sponge:

The study adopted melamine as core material to prepare porous materials possessing superhydrophobic and superoleophilic property, which is utilized to separate polar and non-polar solvents from polar/nonpolar mixture. The sponges were treated by four different methods; (1) acetone treatment, (2) coating of functionalized expanded graphite (FEG), (3) coating of multi-walled carbon nanotubes (MWCNTs) and, (4) coating of reduced graphene oxide (rGO).

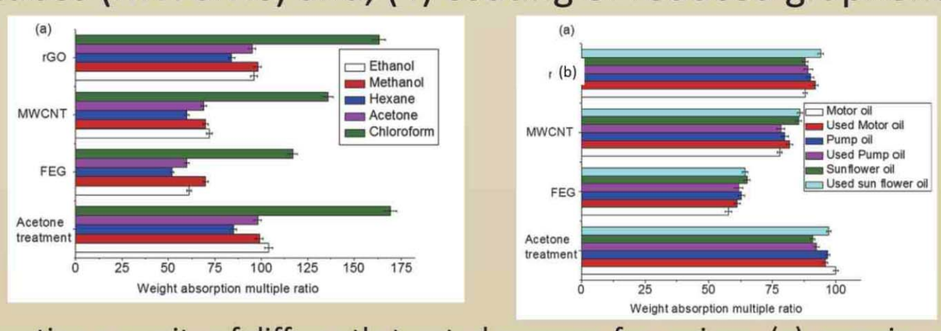

Fig.2. Weight absorption capacity of differently treated sponges for various (a) organic solvents and (b) oils.

(C) Fluid channel for continuous separation of oil and water:

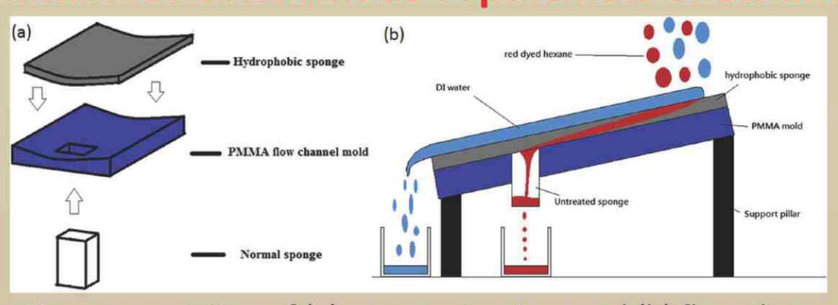

Fig.3. Schematic representation of (a) sponge structure and (b) flow channel model

Research experience: I think that the research is interesting as well as challenging. It challenges you to do some noble work for the betterment of the society. It is giving me hands-on experience in designing the experiments, and simply learning and figuring things out. There are very few or none who have just succeeded in first attempt. In this way, it tests your patience. It requires a lot of dedication and time. I have always been driven by the will to find answers. I hope that I'll keep striving for excellence in my scientific career.

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