NEWSLETTER

Issue 5
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Minister of Science and Technology from China visiting NRF

The Straits Times on December 31, 2019

China's Minister of Science and Technology Wang Zhigang (left) visited NRF and met Deputy Prime Minister Heng Swee Keat (right) on 30 Dec 2019. As a major collaboration programme between Shanghai Jiao Tong University (SJTU) and National University of Singapore (NUS), E2S2 Programme Director made the project presentation to the Minister Wang Zhigang. Finally, Singapore's National Research Foundation and China's Ministry of Science and Technology signed an implementation agreement, which builds on the existing Agreement on Cooperation in Science and Technology, signed between the two countries in 1992.

4th E2S2-CREATE Biochar Workshop (17 January 2020)

4th E2S2-CREATE Biochar Workshop was held in National University of Singapore (NUS) on 17 January 2020, organized by Campus for Research Excellence and Technological Enterprise programme (E2S2-CREATE), which provided a platform for overseas experts on biochar, to share their knowledge with the industry and researchers who are interested in knowing the latest research trends in this exciting field.

COVID-19 Precautions to take

- ⇒ Avoid contact with live animals, poultry & birds
- ⇒ Avoid consumption of raw and undercooked meat
- ⇒ Avoid crowded places and around people who are unwell
- ⇒ Observe good personal hygiene at all times
- ⇒ Wash hands frequently with soap
- ⇒ Wear a mask if you have a cough or runny nose
- ⇒ Cover your mouth with a tissue paper when coughing or sneezing
- ⇒ See a doctor if you are unwell

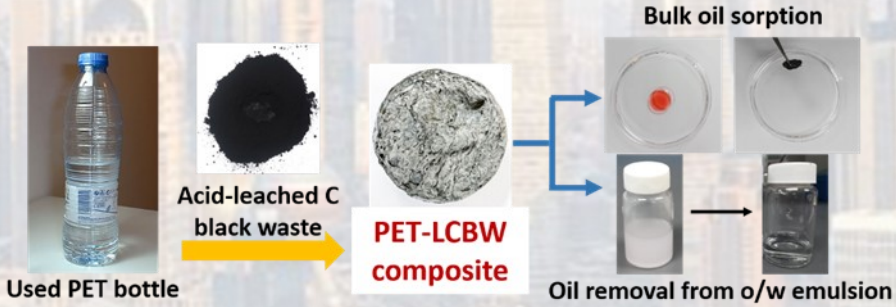
The people behind E2S2 and their contributions.

Dr. Debirupa Mitra

E2S2 Research Fellow

Dr. Debirupa Mitra joined E2S2-CREATE as a Research Engineer in November 2018. After receiving her PhD degree from NUS in December 2018, she was promoted to Research Fellow and has been working with the ES-1 team since then. Dr. Mitra's research interests in E2S2 are focused on reutilization of solid wastes as potential resources to promote environmental sustainability and achieve circular economy.

The scale of global plastic pollution is massive, and overcoming it is a serious challenge. Despite efforts, the recycling rate remains very low because of lack of efficient technologies. Poly (ethylene terephthalate) (PET) accounts for 11.7% of the global plastic waste, a major fraction of which is from single use bottles. While several studies are being carried out worldwide on the recycling of plastic, those reported for PET bottles are limited. In one work, reutilization of used PET bottles was explored as a material for oil sorption. Oil spills in aquatic bodies are a huge threat to the environment and the ecosystem. The use of oil sorbents is one of the most effective ways of containing the oil because of easy clean-up, low production cost and environmental-friendliness. While the oil generally spreads as a thin film over water, the wave action often breaks up the oil creating oil droplets resulting in the formation of oil-in-water (o/w) emulsions. As a result, effective sorbent materials must be able to remove oil from o/w emulsions in addition to absorbing bulk oil. Apart from oil spills, various industries (such as petrochemical, textiles, leather, etc.) generate massive volumes of oily wastewater that requires treatment to regenerate clean water either for reuse or discharge. In this work, LCBW which is acid-leached carbonaceous solid waste from gasification of refinery bottoms, has been entrapped within a PET matrix to fabricate a novel composite oil sorbent material. The results from this study showed that a 3D porous material fabricated by a low energy and facile process, entirely from used PET bottles and carbon waste from the refinery could be effectively used as a sorbent for oil spill containment or for removal of oil from o/w emulsions in the industries.



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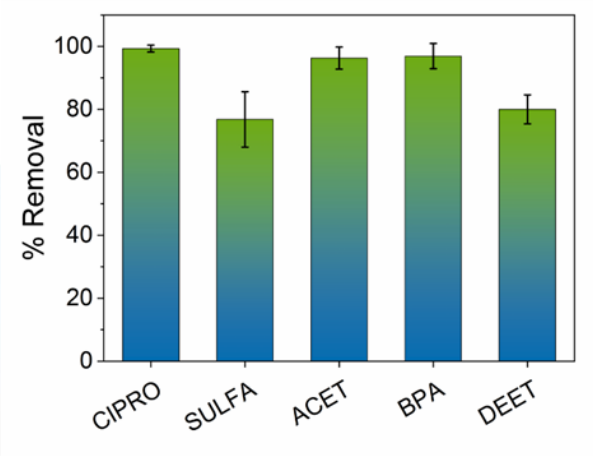
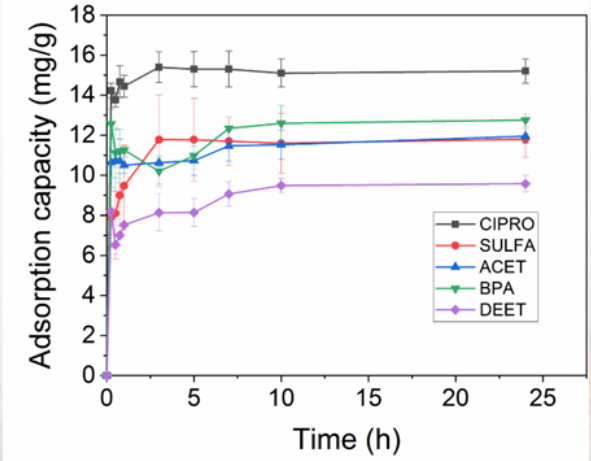
In another work, LCBW is being explored as an adsorbent for the removal of antibiotics and other emerging contaminants (ECs) from wastewater. Accumulation of chemicals like medicines (antibiotics and other pharmaceuticals), surfactants, food additives, plasticizers, personal care products, etc. in the environment is a threat to the aquatic ecosystem as well as to human health. Presence of antibiotics and other ECs have been detected in the effluent of wastewater treatment plants in Singapore and worldwide. Antibiotic contamination is particularly threatening, since it gives rise to antimicrobial resistance in bacteria. While activated carbon is the gold standard for adsorption of pollutants, waste-derived carbonaceous materials are now being investigated as a potential adsorbent. Two kinds of carbonaceous waste were tested: biochar from gasification of wood chips and LCBW. While as-obtained biochar did not show promising results as an adsorbent and would require further modification/treatment, LCBW shows great potential in the removal of ECs such as antibiotics ciprofloxacin and sulfamethoxazole, pharmaceutical acetaminophen (Panadol), plasticizer bisphenol A and mosquito repellent DEET.





The people behind E2S2 and their contributions.

Dr Mao Feijian, Jason

E2S2 Research Fellow

Feijian (Jason) Mao is currently a Research Fellow with E2S2-CREATE. He received his bachelor's degree in biotechnology from Shanghai Ocean University in 2011, and master's degree in environmental engineering from Shanghai Jiao Tong University in 2014. He did his PhD study at National University of Singapore (NUS), supported by E2S2-CREATE Phase I. During his PhD, he focused mainly on the occurrence, fate and toxicity of emerging contaminants in the aquatic environment. As a RF under E2S2 Phase II, he is interested in the rapid monitoring of microorganisms (e.g., phytoplankton, bacteria and virus) in the water system with flow cytometry. Together with the Algal team, he managed to capture two algal bloom events in a local water body and the dynamics of microorganisms therein were characterized by flow cytometry. Further endeavor will be performed to analyze the microorganisms in the water body at high temporal resolutions, tentatively twice a week and once every four hours. The results will be useful for the study of mechanisms and control of algal blooms. In addition, he is also passionate in the application of flow cytometry in the assessment of bacterial viability in the engineering system, such as anaerobic digestion system. Following are selected papers generated from his work:

Selected publications:

Mao, F., He, Y., & Gin, K. Y.-H. (2019). Occurrence and fate of benzophenone-type UV filters in aquatic environments: A review. *Environmental Science: Water Research & Technology*, 5, 209-223.

Mao, F., You, L., Reinhard, M., He, Y., & Gin, K. Y.-H. (2018). Occurrence and fate of benzophenone-type UV filters in a tropical urban watershed. *Environmental Science & Technology*, 52(7), 3960–3967.

Mao, F., He, Y., & Gin, K. Y.-H. (2018). Evaluating the Joint Toxicity of Two Benzophenone-Type UV Filters on the Green Alga *Chlamydomonas reinhardtii* with Response Surface Methodology. *Toxics*, 6(1), 8.

Mao, F., He, Y., Kushmaro, A., & Gin, K. Y.-H. (2017). Effects of benzophenone-3 on the green alga *Chlamydomonas reinhardtii* and the cyanobacterium *Microcystis aeruginosa*. *Aquatic Toxicology*, 193, 1–8.

Zhang, J., **Mao, F.,** Loh, K.-C., Gin, K. Y.-H., Dai, Y., & Tong, Y. W. (2018). Evaluating the effects of activated carbon on methane generation and the fate of antibiotic resistant genes and class I integrons during anaerobic digestion of solid organic wastes. *Bioresource Technology*, 249, 729–736. (co-first author).

Mao, F., He, Y., & Gin, K. Y.-H. Oxidative stress in cyanobacterium *Microcystis aeruginosa* caused by two commonly used UV filters, benzophenone-1 and benzophenone-3. *Journal of Hazardous Materials* (in revision).

Mao, F., Sim, Z. Y., Te S. H., He, Y., & Gin, K. Y.-H. Rapid Monitoring of Algal Bloom Dynamics with Flow Cytometry (in preparation).