PRESENTER INFORMATION

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BIOGRAPHICAL SKETCH

My Ph.D. dissertation compared high-resolution solid-state NMR, high-temperature NMR in the melt, and high-pressure solution NMR in supercritical carbon dioxide (sc CO_2) to investigate fluoropolymers. In addition, I conducted my postdoctoral research at the School of Earth Sciences at Ohio State University, the Max-Planck Institute for Microstructure Physics in Halle, and the Chemistry Institute of New Materials at Osnabrück University. During my postdoctoral period, I studied the dynamics of polymers confined to ordered nanoporous alumina membranes and confined fluids. I am an Associate Research Scientist at the Petroleum Research Center at the Kuwait Institute for Scientific Research, where I have co-supervised the spectroscopy laboratory since 2016.

Throughout my career, I have been an active Principal Investigator and task leader on several research projects that have allowed me to explore polymer thin films, natural edible oils, petroleum chemistry, asphaltene science, vegan food, nanoporous engineered proxies, confined fluids inside nanoporous matrixes, and polymeric fibers prepared by electrospinning and utilizing various spectroscopy and microscopy methods. I have secured external funding for my research, including grants worth over 1.4 million USD in national and international collaborative projects.

My research has resulted in the publication of 45 peer-reviewed articles. Six of these research and review articles have been featured on the cover pages of their respective journals.

TITLE From Sub-Molecular Level Structural Elucidation to Obtaining Nanoporous Crosslinked and Activated Carbon Networks: Converting Problematic Asphaltenes into a Potential Useful Product

ABSTRACT Petroleum asphaltenes are readily available and the heaviest component and by-product of crude oil. Asphaltenes are problematic in their nature and cause severe problems in the petroleum industry. In the present study, we elucidate the structures of asphaltenes at the sub-molecular level by two-dimensional (2D) NMR spectroscopy. Upon clarifying potential reactive functional groups, such as -C=O and -NH, we focus on cross-linking asphaltenes. Successful cross-linking of asphaltenes motivates us to prepare activated nanoporous carbon materials. A thorough characterization of the carbonized nanoporous materials by spectroscopy and thermogravimetric analysis (TGA) confirmed their synthesis. The nanoporosity of the carbonized materials was displayed by scanning electron microscopy (SEM) imaging. Brunauer−Emmett−Teller (BET) surface area analysis shows large surface areas exceeding 2500 and 3000 m^2/g. The newly carbonized materials' architectural rigidity and swelling behavior were tested by the ghost solvent low-field nuclear magnetic resonance (LF-NMR) approach. Finally, the gas adsorption capacity of these materials was tested. The porous carbon structures afforded a hydrogen storage capacity of 2.85 wt % at 1 bar, and the highest uptake of CO_2 at 1 bar is 28.95 and 19.15 wt % at 0 and 22 °C, respectively. Nanoporous carbonized asphaltenes are promising materials to be applied in various areas as gas-absorbing and CO_2-capturing proxies. We suggest that the current materials could be good proxies for other applications in microelectronics and solid-state batteries because heteroatoms such as sulfur are still detectable in the final carbonized nanoporous materials.


NETPORE
Network on porous
semiconductors and oxides