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ABSTRACT:

Synthesis of Zeolite-Templated Carbons using Unconventional Carbon Precursors and Waste-Derived Zeolite Feedstocks for Hydrogen Storage Application

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Porous materials such as zeolites, activated carbons, and porous coordination polymers have attracted significant attention for adsorption and energy-related applications. Within this landscape, zeolite-templated carbons (ZTCs) have emerged as particularly promising sorbents because they offer highly ordered porosity, high surface areas, narrow pore-size distributions, and large pore volumes. These properties make ZTCs attractive for gas storage and separation, CO₂ capture, and electrochemical energy storage (e.g., supercapacitors and batteries). Despite their potential, the commercial deployment of ZTCs remains constrained by the high cost of production, largely associated with reliance on commercial zeolite templates and carbon precursors. Consequently, increasing effort has been directed toward lowering synthesis costs by using unconventional carbon feedstocks and zeolite templates derived from waste streams. In this talk, I will present our past and ongoing work on synthesizing ZTCs using zeolites produced from clays, pyrophyllite and coal fly ash as low-cost templates, alongside waste-derived carbon sources including waste tyre pyrolysis oil vapour and biomethane. I will also compare the structural and textural properties of the resulting ZTCs and present their comparative performance for hydrogen storage applications.