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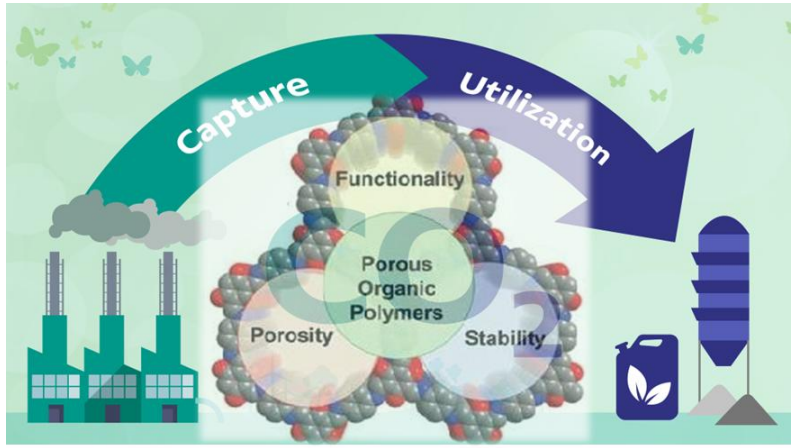
Design of Advanced Porous-Organic-Polymer (POP): Unifying System for CO_2 Capture & Utilization

Abstract: CO_2 emissions from the global use of fossil fuels are expected to exceed 45 billion tonnes by the year 2040. At the 26th Conference of Parties (CoP26), India committed to reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030. Hence, there is a growing demand for the development of effective carbon capture and utilization (CCU) technologies to minimize the atmospheric CO_2 levels. Absorption technology for carbon capture is limited by high energy requirement for solvent regeneration, solvent degradation and corrosion issues. In contrast, adsorption-based technologies are limited by the availability of adsorbents with high CO_2 adsorption capacity, selectivity, regenerability and long life. Considering CO_2 utilization aspect, with the various available strategies, photochemical CO_2 reduction to hydrocarbon fuels and other high-value chemicals has attracted the attention because it offers a road to clean, cost-effective, energy-efficient, and sustainable CO_2 reduction pathway. In addition, superior product selectivity, higher efficiency, and long-term CO_2 reduction durability can be achieved *via* photochemical approaches, which subsequently turn anthropogenic CO_2 into a valuable commodity. Our research group played a pioneering role to explore a variety of Porous-Organic-Polymers (POPs) with high surface areas, low skeleton density, controllable compositions, powerful nanoconfinement effects which have provided a new dimension in photocatalytic CO_2 reduction to value added chemicals, selective CO_2 adsorption, photocatalytic CO_2 fixation, thereby announcing new opportunities for various specific topics in the advancement of CCU technologies in the near-future.



References: *J. Am. Chem. Soc*. **2023**, *145*, 422-435; *Angew. Chem. Int. Ed*. **2023**, *62*, e202311304; *Small* **2024**, *20*, 2305307; *ACS Appl. Mater. Interfaces* **2024**, *16*, 22066-22078.

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