Designing Porous Organic Polymers for Sustainable Processes

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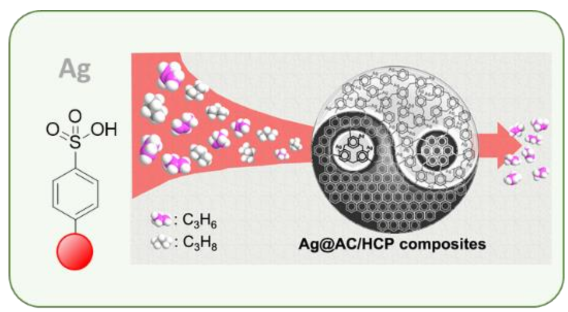
Porous organic polymers (POPs) are exciting materials for a wide range of applications due to their high surface areas, tuneable textural properties, and excellent chemical, thermal, and mechanical stabilities. The vast number of synthetic routes to POPs permits readily modifiable chemical functionality and/or broad bottom-up design.

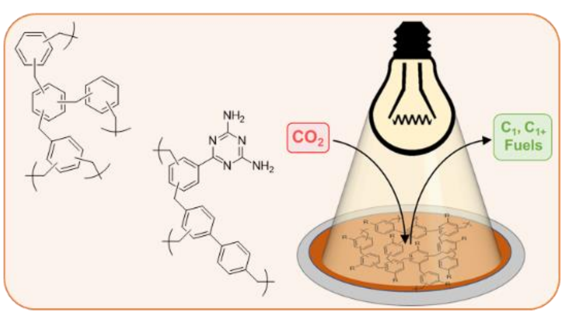
Hypercrosslinked polymers (HCPs) are a low-cost class of POPs with excellent tunability. HCPs are densely crosslinked amorphous networks, produced using simple Friedel–Crafts chemistry. HCPs are synthesised from non-functional aromatic compounds (i.e. without specifically polymerisable groups) and require only abundant Fe- or Al-based Lewis acids or even simple organic acids as polymerisation catalysts. Owing to their low costs and broad design scope, HCPs are developed for a variety of applications including gas separation and storage, solid-state extraction, and energy storage.

In this talk, I will describe some of our previous and ongoing work in both the design of new and innovative routes to HCPs, as well as their implementation in applications for improved sustainability. In HCP production, we are investigating ever simpler routes to networks, aiming to reduce waste without sacrificing performance. In their utilisation, we employ HCPs in a broad range of applications, including as heterogeneous catalysts for liquid-phase transformations, photocatalysts for CO_2 photoreduction, and even as electrode materials in energy storage. Given the versatility of HCP synthesis, an unfathomable number of design iterations are possible, presenting a huge opportunity to use HCPs as a platform for robust designable organic adsorbents for sustainable processes.

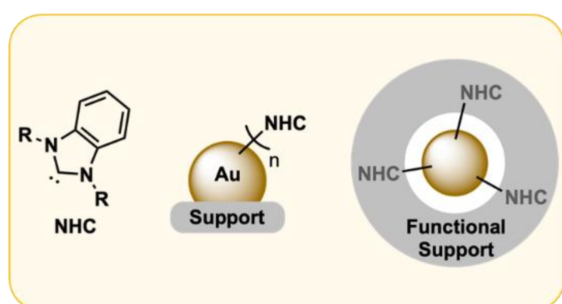
*Polymer **synthesis routes** and design*



Separation / Storage



Photocatalysis



Catalyst supports