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Expandable Covalent Organic Frameworks

Covalent Organic Frameworks (COFs) are novel porous organic materials, inspired by Metal-Organic Frameworks (MOFs) which feature only covalent bonds and do not contain heavy metals. COFs retain a well-ordered, crystalline and porous. The potential properties and structural diversities of COFs make them extremely promising materials for a wide range of applications such as gas separation and storage, catalysis, optoelectronics and photovoltaics.

However, the high crystalline nature of COFs makes them insoluble in solvents and they cannot be processed in melt state despite their high thermal stability. Although the porosity of COFs is high and their pores are well ordered, the size of these pores is limited to a few nanometer and preparation of COFs with additional properties is difficult. In contrast porous materials made from classic polymer materials exhibit much lower pore density and order but have better processability and can be relatively easily functionalised.

The focus of my thesis project is to develop a novel class of COF building blocks with embedded polymerisable sites, and assemble expandable building blocks to fabricate 2D or 3D COF. The pore dimensions of these COFs, prepared from robust methods (boroxine formation), will be adjustable using controlled polymerisation.

This novel class of COF can be characterized by XRD, XAXS, FT-IR, SEM, nitrogen adsorption as well as NMR in solvents and solid state.

Growing soft polymers chain within the walls of the expandable COF building blocks will allow the controlled modification of their shape and size, and introduce desirable functionalities by using different monomers in polymerisation. And on the other hand improve processability of COF materials. This novel class of COF can be designed for numerous applications for example gas storage and separation or thin films for organic solvent filtration.