Solid-state materials for energy applications

Our research group is interested in the design, synthesis and characterisation of new solid-state materials for energy applications. This includes materials for thermoelectric power generation, as well as porous materials for gas storage, gas separation and sensing applications

1. New thermoelectric materials for energy recovery

Thermoelectric materials convert thermal energy into electrical energy and find applications in devices for power generation. Such devices enable energy harvesting from waste heat, and can therefore be used to increase energy efficiency and reduce CO$_2$ emissions. To improve the efficiency of thermoelectric power generation, we are currently investigating a range of potential thermoelectric materials, including skutterudites, nanostructured materials and low-dimensional systems.

2. Microporous materials

Porous materials, containing molecule-sized channels and cavities, are promising for both hydrogen storage and CO$_2$ separation. Porous materials with semiconducting behaviour have potential for a number of additional applications, including molecule discriminating sensors (or “chemical noses”). Much of our research focuses on the design of novel porous semiconductors, containing sulphide, selenide or telluride units.

3. Hybrid porous materials containing supertetrahedral clusters

Porous solids containing both inorganic and organic components are known as metal-organic frameworks. We are exploiting supertetrahedral clusters for the design of new metal-organic frameworks. Recent examples of materials prepared in our group include a crystalline material containing corrugated layers with pores in the mesoporous range (3 nm), a material containing discrete chiral metal-organic tubes of 3 nm diameter and a 2-D structure in which both inorganic and organic linkages coexist.
Selected publications