



University
of
St Andrews

St Andrews Chemistry @ 200

A celebration of chemical research

Framework Solids

Lecture theatre C at 3 pm on Wednesday 9th March 2011

15:00 Prof Thomas Bein, Ludwig-Maximilians-Universität München

“Adventures in and with nanopores: From intrachannel dynamics to oriented surface-growth”

16:00 Prof Paul Wright, St Andrews

“Making Space for Molecules: Synthetic Strategies Towards New Microporous Sorbents and Catalysts”

16:40 Prof Russell Morris, St Andrews

“MediMOFs - Potential uses of metal organic frameworks in medicine”

17:20 Wine Reception (Common room)

/Abstracts

Adventures in and with nanopores: From intrachannel dynamics to oriented surface-growth

Professor Thomas Bein

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Mesoporous materials made through the cooperative surfactant-controlled self-assembly and condensation of precursor building blocks offer very large surface areas and pore diameters, control of the internal surface chemistry through molecular functionalization, and great flexibility regarding their morphology. To adapt these channel systems to various intended functionalities, it is of interest to control their orientation and morphology. We describe a combination of fluorescence microscopy with a technique known as micromolding in capillaries (MIMIC) to gain insights into the domain size, correlation length and pore directionality in mesoporous silica structures. Mesoporous thin films are also being studied as model host for the diffusion of guest molecules. Specifically, we investigate the diffusion and stabilization of dye molecules and bioactive molecules in the silica nanochannels. Unprecedented insights into the diffusional behavior correlated with the real space structure of the channel system have been obtained by combining single molecule microscopy with transmission electron microscopy of the same sample area. Mesoporous silica systems are also of great interest in novel concepts for targeted drug delivery. We show that the multitude of functionalities required for successful drug delivery, including safe storage and enclosure of the active component, biocompatibility and biostability, and triggered release at the desired location can be addressed by building multifunctional core-shell mesoporous silica systems. We will discuss examples regarding release kinetics, biofunctionalization of mesoporous nanoparticles, various triggered molecular valve systems, and mechanisms of cell-entry and intracellular release.

Metal-organic frameworks (MOFs) assembled from organic building blocks and metal-based connectors have attracted much interest due to their large pores and their enormous structural diversity. Particularly, the generation of homogeneous thin films of MOFs is highly desirable in view of potential applications including chemical sensors, catalysts as well as optical devices. We have recently developed direct growth methods from solution for oriented MOF layers on self-assembled monolayers. Here we will discuss a novel strategy for the growth of highly oriented thin films of MOFs, based on the storage of one reaction partner for framework synthesis in a polymer gel layer, followed by diffusion of the other reaction partner into the gel layer and to a nucleation interface provided by a functionalized self-assembled monolayer. Moreover, we have grown oriented thin films of functionalized MOF crystals and studied their adsorption behavior on piezoelectric devices. This approach offers a general platform for the design of selective chemical sensors.

Making Space for Molecules: Synthetic Strategies Towards New Microporous Sorbents and Catalysts

Prof Paul Wright

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Crystalline, microporous solids offer an unparalleled opportunity to combine diverse applications in adsorption and catalysis with the ability to understand their structure-property relationships. They possess great chemical and structural variety, and in this talk I will describe examples of our group's progress in the synthesis of novel families of microporous solids, both zeolitic and metal organic frameworks, via designed routes, their structure solution and multi-technique characterisation, and their applications in environmental catalysis and carbon capture.

“MediMOFs - Potential uses of metal organic frameworks in medicine

Prof Russell Morris

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Metal organic frameworks (MOFs) are some of the most exciting aspects of nanotechnology to have emerged in the last decade. Their extreme porosity makes them particularly attractive for application in gas storage technologies. In this presentation I will discuss how such gas storage can be coupled with controlled delivery to produce materials suitable for medical gas delivery. I will explain how the high gas capacities of different MOFs can be used to tailor materials for applications and how the medical gases can also be used to probe unusual properties of the materials themselves.