ORGANIC SYNTHESIS OF FUNCTIONAL NEW MATERIALS

The properties of a material are a function of its molecular components. The properties of a molecule are, in turn, dependent upon the type and orientation of its functional groups. Organic synthesis provides us with a way of programming the type and orientation of functional groups on a given organic framework and therefore the basis for designing new materials.

Several projects are available within each of the three broad areas outlined below and examples of other research areas of interest include the design of new colorimetric/fluorescent sensors, the development of chiral stationary phases for the resolution of enantiomers, the development of non-chromatographic methods to resolve Tröger's base enantiomers, and synthesis of artificial light-harvesting systems. Dr. Try is available for a discussion on any aspect of the projects. All of the research areas are interdisciplinary in nature and involve organic synthesis and access to a wide range of modern instrumentation for characterisation of new materials.

CHIRALITY TRANSCRIPTION OF RIGID MOLECULAR SCAFFOLDS TO HYBRID SILICAS (with Ecole Nationale Supérieure de Chimie de Montpellier, France)

We are interested in utilising a series of related molecular frameworks, in the synthesis of chiral hybrid silicas. As can be seen from the X-ray crystals structures shown below, we have control over the shape of frameworks, and we also have control over the type and placement of a variety of functionality available on the aromatic rings.

We aim to use this control to prepare a range of hybrid silicas of the type shown in the SEM images on the right, which were prepared by our collaborators in Montpellier; the helicity of the fibre-like bundles was always right-handed for the materials obtained from (R,R)-1,2-diaminocyclohexane and left-handed when the (S,S)-enantiomer was used as the organic framework. The resultant hybrid materials are expected to find application in the areas of heterogeneous asymmetric catalyst design and chiral chromatographic separation.

SYNTHESIS AND CHARACTERISATION OF NEW FLUORESCENT BORON COMPLEXES

Research in the area of novel organic fluorescent dyes continues to develop due to their various applications. Despite the immense interest and research in the area there is still much more to be done to produce the ideal fluorophore. The ideal fluorescent dye should be chemically and photo physically stable, exhibit excellent photo physical properties and be easily tunable to emit in different regions of the visible-NIR spectrum. Boron complexes are known to have high quantum yields, large absorption coefficients, long excited life times and good chemical stability.
In this project a new series of ligands and their boron complexes will be designed, synthesised and characterised. The figure to the left shows the solid state fluorescence of a recently prepared series of compounds, under irradiation at 365 nm light.

The image highlights the tunability available within this family of compounds.

**CHIRAL LIQUID CRYSTALS (with Kent State University, USA)**

Liquid crystals can be regarded as a fourth state of matter. A liquid crystalline phase (mesophase) is one the disordered isotropic (liquid) state, but exists only for molecules possessing a certain set of parameters. Chiral liquid crystals are a subclass of these compounds. These molecules display desirable properties that are exploited in display devices such as watches, clock radios, calculators and laptop computer screens.

Three important features present in liquid crystalline molecules are the incorporation of a polarisable group (as this helps to orient the molecules in a given direction in the presence of an applied electric/magnetic field), a rigid region (typically an aromatic ring) and the presence of one or more flexible chains. In this area we are interested in incorporating long alkyl chains linked to novel chiral scaffolds by a variety of functional groups.

Structure-property studies will then be carried out using Differential Scanning Calorimetry (DSC) and polarised-light microscopy in order to determine, and ultimately predict, how variations in properties of the bulk liquid crystalline phase result from a series of subtle electronic and orientational changes to the structure of the scaffolds of the individual molecules.

**Selected publications**


cbms.mq.edu.au/academics/atriy.html