MOLECULAR MAPS to CONTROL the FABRICATION of INORGANIC MATERIALS

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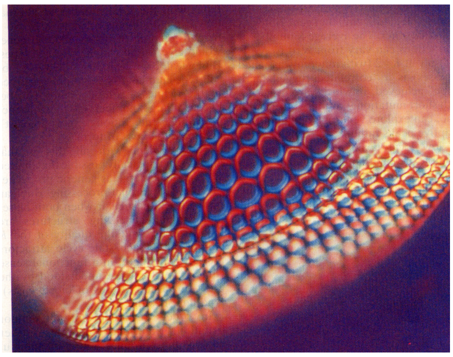
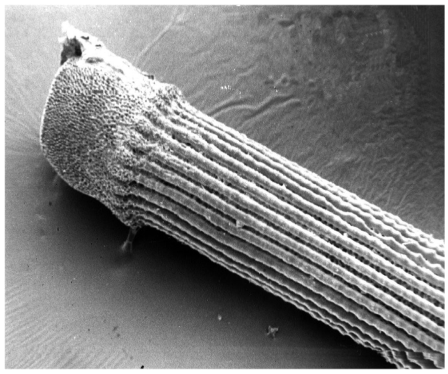
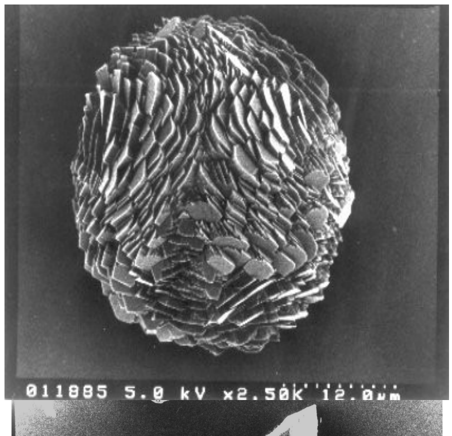
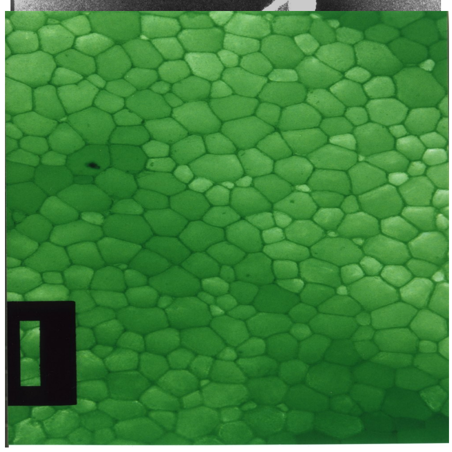




The development of effective protocols for the control of crystal structure, size and morphology attracts interest because of the requirement for particles of modal size and shape in many areas of particle processing and the importance of crystallochemical selectivity in determining the exploitable properties of crystalline solids. When seeking new routes to optimise and control crystal growth it is appropriate to review the many examples of advanced "crystal engineering" which occur in nature. Bio-crystalline materials are deposited in a highly controlled manner to produce crystal phases that are unique with respect to their structure, habit, uniformity of size and texture. Moreover, a casual appraisal of biomineralisation makes it clear that 'nature' has evolved unique crystallisation strategies that circumvent the accepted thermodynamic directives normally controlling crystal nucleation and growth. The result is the facilitated fabrication of inorganic materials tailored for precise functional use. The elucidation of these strategies so that they can be mimicked, adapted and controlled to produce novel materials with enhanced properties is now the common goal of materials scientists, gene technologists, microbiologists, protein chemists, structural engineers and crystal chemists.

Despite the clear evidence that a relatively complex array of strategies has evolved for regulating crystal growth in vivo, one feature is common to the biological paradigm. Interactions between supramolecular organic structures and the nascent inorganic solids play a fundamental role in controlling the deposition of biominerals and ordering their assembly into functional hierarchical structures. In order to gain a better understanding of the molecular recognition events, which take place at the organic-inorganic interface, a bio-inspired crystal chemical approach has been adopted. For this work the feasibility of using auto-assembling molecular templates to control nucleation and growth is under consideration. This approach to the engineering of crystals has the advantage of providing a route to control the interfacial chemistry by molecular recognition through the synthesis of tailored organic templates (head group identity, polarity, spatial ordering, etc.,) in order to initiate and regulate crystal growth. By adopting ideas and concepts derived from biomineralisation this novel interdisciplinary approach to the engineering of crystals has brought about the successful integration of organic supramolecular chemistry and molecular self-assembly with the classical elements of inorganic synthesis and materials science to open new horizons in materials research.





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Professor Heywood is head of the School of Chemistry and Physics and has, since 1996, held the established **Chair of Inorganic Chemistry** at Keele University. Her research career developed out of the discipline transition from applied biological sciences to materials chemistry fostered by an initial interest in the controlled growth of inorganic crystals in biological systems, *biomineralisation*. Subsequently, the application of crystal science to issues ranging from normal and dystrophic mineralisation processes, structure-function relationships in inorganic materials, the development of novel strategies to control crystal formation and the formation of novel, functional inorganic-organic hybrids have evolved as key research topics within her multidisciplinary research programme. The Crystal Science Group at Keele (11 students , four postdocs) currently hosts some fifteen independent research projects which draw iterative funding support from both UK (EPSRC, DTI, DERA) and international (USA, Holland, Australia) funding agencies and Industry. BRH is a consultant in *Crystal Science* to several major companies within Europe.
More recently research effort has been directed towards the development of novel molecular templates to control the nucleation and growth of inorganic materials with a view to optimising specific functional properties. The juxtaposition of experimental studies in crystal habit control with developments in the field of computational modelling of the solid state (in collaboration with Jackson at Keele and Catlow at the RI) is another key research endeavour.

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