



A Nanotechnology Approach to Environmental Remediation

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Nano-bio at Sheffield

- The Sheffield Cell-Mineral Interface (C-MI) programme (www.shef.ac.uk/c-mi).
- The aim is to pursue cross-disciplinary research excellence in cell-mineral interface research.
- £1.4M programme links strengths in Environmental Engineering Science to those in Surface Chemistry, Nanotechnology, Biological Imaging and Molecular Biology.
- The programme is funded primarily by the Engineering and Physical Sciences Research Council (EPSRC), with additional support from the Biotechnology and Biological Sciences Research Council (BBSRC) and The University of Sheffield.



Why Cell-Mineral Interface?

Important clues in current understanding of biodegradation point to the importance of interfacial processes in aquifers.

- Biological activity in aquifers predominates as attached growth
- Micro-organisms preferentially colonise surfaces containing limiting nutrients
- Anaerobic biodegradation relies on spatially intimate fermentation and respiration within biofilms
- Respiration in the absence of soluble oxidants remains robust through sparingly soluble mineral oxidants



Objectives

- Quantify rates of biodegradation with the numbers and activity of attached microbial colonies on minerals and rock.
- Characterise the physical and community structure of biofilms with molecular biology methods and fluorescence microscopy.
- Elucidate the biological physical chemistry of the cell surface that controls microbial attachment on minerals at the molecular level.
- Investigate the genetic control of cell attachment to solid surfaces.
- Develop a fundamental understanding of how biofilms and related biodegradation activity respond to environmental conditions.
- Develop a framework to predict trends in attached growth and biodegradation activity and test against field-scale observations.



Current state of research

We currently have projects integrated within the programme on;

- Cell and mineral surface chemistry
- Molecular microbiology of biofilms
- Biological imaging of microbial biofilms
- Development of reporter gene biosensors
- The chemistry of microbial cell wall macromolecules
- The physical chemistry of cell-mineral interactions
- Chemical modelling of cell-mineral interactions
- Observation of environmental samples from contaminated sites



Future research

Proposed new research activity with partners around the UK and overseas includes

- Selectivity of biosensors
- Fungal-mediated weathering in the formation of soil
- Microbial catalysis of metal oxidation for mine water treatment
- Mathematical modelling of attached growth ecosystems



Contacts

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