Nanotechnology Focus Group Meeting
Research Activities

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School of Applied Sciences, RMIT
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Nanotechnology Focus Research Group - Purpose

• Global perspective

Three major challenges that the world is expected to face in the coming years include Climate change, Energy deficiency, and Health issues.

• RMIT’s capabilities in Nanoscience and technology

RMIT has strong expertise in several key nanotechnology areas including –
  – Tailored synthesis of functional materials for various applications (catalysis, sensing, photonics, biomedicine, climate, water, energy, etc)
  – Thin films, nanofabrication and devices
  – Materials modelling and simulation
  – Other fundamental studies associated with nanomaterials

• A potential integrated approach to address these major challenges

In the globally competitive research environment, RMIT can probably create its own space by addressing these issues collectively and focusing on ‘impact-based research’
Advanced Functional Nanomaterials Group – Nanotechnology Research Strengths

Prof. Peter Coloe
A. Prof. Trevor Stevenson
A. Prof. Peter Smooker
A. Prof. Andreas Lopata
A. Prof. Simon Cowell
A. Prof. Moshi Geso
A. Prof. Kourosh Kalantar-zadeh

ORGANO-METALLICS

Peter McCallum Cancer Center
NCCS, India
NCL, India
IICT, India
Southeast University, China
Nanjing University, China

Electrocatalysis – H₂

CO₂

Hg
Shape controlled synthesis of colloidal nanoparticles – Chemical Route

Galvanic Replacement in Water

Galvanic Replacement in Ionic Liquid

*Electrochem. Commun. 2009, 11, 1639*
Shape controlled synthesis of colloidal nanoparticles – Chemical Route

Ag nano-spheres
Ag nano-cubes
Ag nano-prisms

Silica coated magnetic particles
Shape controlled synthesis of colloidal nanoparticles – Biological & Biomimetic Route

Amino acids-mediated synthesis of silica nanoparticles in ionic liquid

Histidine-silica

Arginine-silica

Lysine-silica
Shape controlled synthesis of colloidal nanoparticles – Biological & Biomimetic Route

Phytase enzyme-mediated synthesis of silica nanoparticles in ionic liquid

- Hollow Silica
- Solid Silica

Phytase enzyme-mediated synthesis of metal nanoparticles in ionic liquid

- Au nanoprisms
- Flat Pt nanostructures
- Hollow Pt spheres
Synthesis of Polypeptide Nanocapsules for Drug-delivery

Nano Lett., 2008, 8, 1741
Adv. Mater. 2009, 21, 1
Shape-controlled synthesis of nanostructures on substrates

Platinum nano-trees

Gold nano-spikes

Gold nano-prisms

1 µm

500 nm

1 µm

500 nm

Langmuir, 2009, 25, 3845
Chem. Commun. 2009, 5039
Applications of Nanomaterials – Polymer Nanocapsules in Drug Delivery

Nano Lett., 2008, 8, 1741
Adv. Mater. 2009, 21, 1
Nanomaterials Applications – Magnetic nanoparticles as contrast agent for MRI

Mouse 1 Mouse 2
Both Mice before contrast

Mouse 1 Mouse 2
No MRI agent MRI Agent
Applications of Nanomaterials –
Shape dependent antimicrobial applications of silver nanoparticles
Nanomaterials Cytotoxicity Studies

- **MTT Assay**
  - 24 h
  - 48 h

- **RNS determination**
  - 24 h
  - 48 h

- **Pro-inflammatory cytokines**
  - ELISA analysis
  - RT-PCR analysis
Applications of Nanomaterials – Electro-catalysis and sensing

Hydrogen evolution
Crystallography dominates

Glucose detection
Surface site activity and crystallography

SERS Sensing of Biomolecules

Hydrazine Oxidation

Ref:
Langmuir, 2009, 25, 3845
Chem. Commun. 2009, 5039
Applications of Nanomaterials – Hg sensing

![Graph showing Hg sensing data](image1)

- **Electro-deposited**
  - N=42
  - Hg Concentration, (mg/m³)
  - Δf (Hz)

- **Non-modified**
  - N=62
  - Hg Concentration, (mg/m³)
  - Δf (Hz)

N = number of point in each data set

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by Galina Kazarina

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Research Impact

Learning from nature’s clues

As the first wave of nanotechnology continues to mature, scientists are looking into how nature has solved complex problems. One example is the self-regulating temperature control of the human body. The body responds to sudden changes in temperature by activating its own cooling or heating mechanisms. A new way of creating temperature control is being explored, inspired by nature’s own ability to regulate heat.
Promising Future: Multifunctional Delivery Vehicles

- Quantum Dots
- Magnetic particles
- Hydrophilic anticancer drug with a biodegradable polymer
- Hydrophilic anticancer drug in an oil
Thank You