IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

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| **Project Title:** | **Theranostics hydrogel particles for arterial -thrombosis** | |
| **Project Number** | **IMURA0886** | |
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| **IITB Department**: | Biosciences & Bioengineering | |

## Research Clusters:

**Highlight which of the Academy's CLUSTERS this project will address?**
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

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| 1 | *Material Science/Engineering (including Nano, Metallurgy)* |
| 2 | *Energy, Green Chem, Chemistry, Catalysis, Reaction Eng* |
| 3 | *Math, CFD, Modelling, Manufacturing* |
| 4 | *CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control* |
| 5 | *Earth Sciences and Civil Engineering (Geo, Water, Climate)* |
| 6 | *Bio, Stem Cells, Bio Chem, Pharma, Food* |
| 7 | *Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng* |
| 8 | *HSS, Design, Management* |

## Research Themes:

**Highlight which of the Academy's Theme(s) this project will address?**
*(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

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|---|---|
| ***1*** | *Advanced computational engineering, simulation and manufacture* |
| 2 | *Infrastructure Engineering* |
| 3 | *Clean Energy* |
| 4 | *Water* |
| 5 | *Nanotechnology* |
| 6 | *Biotechnology and Stem Cell Research* |
| 7 | *Humanities and social sciences* |
| 8 | Design |

## The research problem

Thrombosis occurs when a blood clot forms either in a vein or an artery. The clot is known as a thrombus which may lead to serious cardiovascular complications. There are various therapeutic strategies used for the treatment of thrombosis but all have some limitations. Internal bleeding is the major limitation in most cases. Thus there is a need for a system which can detect the thrombotic clot and deliver the drug via direct targeting and site specific release.

Thrombi contain activated platelets and fibrin that can be targeted by therapeutics. We propose to use theranostic injectable hydrogels particles (< 1μm) as the solution for thrombosis. The proposed hydrogel particles comprise anti-thrombotic drug loaded or nanoparticles and contrast agents. These smart hydrogel particles will detect the clot and deliver the drug loaded particles or drug directly to the clot upon external trigger (example: ultrasound) or internal trigger. The major advantage of this approach is that it will deliver the therapeutic agent to the clot and thus reduce the side effect of internal bleeding. Another advantage is that injectable hydrogels have long shelf life and they are easy to upscale, rendering the system translatable to clinics.

## Project aims

1) To develop smart hydrogel particles that are specifically enriched at the thrombus for imaging
2) To develop smart hydrogel particles that are targeted towards the thrombus and release of their therapeutic drug load upon internal or external trigger.

## Expected outcomes

1) Generation of hydrogel particles that can be used for the detection of thrombus.
   Several imaging modalities will be applied, such as ultrasound, magnetic resonance imaging, CT, and fluorescence imaging.
2) Generation of hydrogel particles that can deliver the drug upon external or internal trigger with minimal side effects.

## How will the project address the Goals of the above Themes?

The project is based on Prof Banerjee's unique expertise and skills to generate smart nanoparticles, Hydrogel particles, contrast agents for various imaging applications and Prof Peter's extensive expertise in nanoparticle targeting and the assessment of their biological effects in a newly developed mouse model of thrombosis and atherosclerotic models. Thereby the focus of the project is very much aligned with the theme of material science/engineering of nanoparticles specifically for medical application.

## Capabilities and Degrees Required

Masters in Biotechnology or Pharmaceutical Sciences or Biomedical Engg or Chemical Engg or Nanotechnology

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

**Nanotechnology, molecular imaging, drug delivery, thrombosis**