

An Indian-Australian research partnership

Project Title:	Development of drug eluting intelligent coating on medical stents	
Project Number	IMURA0974	
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Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see www.iitbmonash.org)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

Define the problem

This PhD project will focus on the development of a drug eluting coating technology on stents. The work would broadly involve: (1) To develop micro/nano-scale structures using laser or plasma treatment on stent material surfaces providing strong adhesion to biomaterials such that the hydration state is also maintained; (2) To explore the intrinsic interactions to help designing the drug eluting coating, with final coating thickness and drug release rate controllable for stent use; and (3) cytotoxicity tests *in vitro* to confirm the biocompatibility of the newly developed coating. The ability to deliver drugs such as chemotherapy agents through coating on stent would be an ideal for direct treatment at specific locations, a solution potentially to replace repetitive supervised injections.

Project aims

Define the aims of the project

1. To develop a drug eluting intelligent coating on ureteric stents for use in cancer treatment.
2. Develop a laser texturing technique for generating micro-scale structures on polymer stents and understand the influence of process parameters on surface features.
3. Experimental study to understand the correlation between textured surfaces and effective hydrogel coatings based on the drug release rates.
4. Develop a high repeatability strategy for coating drug eluting layer on ureteric stents.

Expected outcomes

Highlight the expected outcomes of the project

1. Development of a novel coating technology for drug eluting stents
2. Use of short and ultrashort pulsed lasers for fabrication of textures or micro-scale structures for strong adhesion of biomaterials.
3. Understanding the effects of different types of coatings on drug release rate.
4. Patents and publications in high impact journals

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The research would lead to the development of a novel site-specific coating technology for stents. The research would involve both experimental as well as computational methods. This would address the goals of theme 'manufacture'. The ultimate objective is to develop a drug eluting stent to deliver chemotherapy drugs for upper tract urothelial cancer treatment, a critical clinical application.

Potential RPCs from IITB and Monash

Provide names of the potential research progress committee members (RPCs) and describe why they are most suited for the proposed project

1. Prof. Suhas Joshi (Mechanical Engineering, IIT Bombay): He has expertise in surface texturing using lasers and plasmas. A majority of the work deals with surface texturing using lasers

2. Prof. Shobha Shukla (MEMS, IIT Bombay): She is an expert on processing of polymers using femtosecond lasers. The stent material is made of polymer.
3. Prof. Jian Li (Monash Biomedicine Discovery Institute, Monash University): The project is related to drug delivery, which is one of his research areas.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

Qualifications:

B.Tech/M.Tech in Mechanical Engineering, Materials Science and Engineering

Essential skills: Computer programming in C/C++, Python, or MATLAB, background in heat transfer, materials science.

Additional skills (not mandatory):

Fundamental understanding of biomedical engineering and lasers

Necessary Courses

Name three tentative courses relevant to the project that the student should complete during his/her coursework at IITB (the student will require to secure 8 point in these courses)

1. ME 677: Laser material processing
2. BB 601: Introduction to Bio-nanotechnology
3. ME 794: Statistical Design of Experiments

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

1. Prof. Jian Li (Monash Biomedicine Discovery Institute, Monash University)
2. Prof. Amit Agrawal (Mechanical Engineering, IIT Bombay)

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.

Novel functional materials, Biomedical engineering