IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Peptidomimetic oligoacrylamides as ion channel mimics and biomaterials**	
Project Number	**IMURA0796**	
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Research Clusters:

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

Peptides are used in a variety of applications in the biomedical field. Yet, peptides are only of limited stability due to the action of enzymes present in biological environments that hydrolyse the amide backbones of the materials. This hurdle can be overcome by peptidomimetic approaches. The best way to avoid hydrolysis of peptides is to create stable carbon-carbon backbone structures. Via very recently discovered approaches of the Monash research group, such oligomeric materials have become available for peptide mimics up to chain length 10 on the basis of oligoacrylates and oligoacrylamides. While first proof of principles demonstrate that these oligomers possess biological functions, it is mandatory to push the field further. In here, the question is raised if these materials can also form complex self-assembled nanostructures such as ion channels, analogous to their peptide counterparts. Having access to such complex structures would enable a plethora of new applications

Project aims

The project aims at the synthesis and self-assembly of peptide mimics based on acrylate and acrylamide chemistry. For this aim, a library of acrylate and acrylamide monomers that carry the typical amino acid side chains available at Monash University will be used to form specific monodisperse and sequence-defined oligomers following the single-monomer-unit-insertion (SUMI) concept. At IITB, these oligomers will then be used to self-assemble these materials into complex shape and to evaluate those for their suitability to act for example as ion channels using biophysical assays and electrophysiology measurements.

Expected outcomes

The expected outcome of the project is a deeper understanding of self-assembly processes of synthetic peptide analogous oligomers. Sequence-defined materials have only surfaced very recently in the field of preparative organic and polymer chemistry, and the vast potential of these exciting materials is not yet explored. Further, availability of synthetic materials that can act in the same way as peptide-based nanostructures will allow for novel applications that make use of biological concepts, but that are useable in harsher non-biological environments. Several high-impact publications and eventually patent applications can be expected from thesis work in this field.

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

The self-assembly of oligoacrylates and oligoacrylamides following peptide concepts falls clearly into the field of nanotechnology. Superstructures based on these rather small oligomeric chains can reach sizes in the upper nanometer range and allow for tailor-made design of oligomers towards certain structures and functionalities of these nanomaterials. While based on natures design, application of the to-be-obtained nanomaterials stretches much further than biological systems, and can become important for nanoelectronics or energy storage to name some examples.

Capabilities and Degrees Required

-knowledge in organic chemical synthesis
-base knowledge on contemporary polymer chemistry
-nanochemistry and properties of nanomaterials
-basic knowledge on biomolecules

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
Nanotechnology,nanoscience
Materials Chemistry/Science
Bio Chemistry