

An Indian-Australian research partnership

**Project Title:**

**Project Number**

**Monash Main Supervisor**  *Full name, Email*  
(Name, Email Id, Phone)

**Monash Co-supervisor(s)**   
(Name, Email Id, Phone)

**Monash Department:**

**IITB Main Supervisor**  *Full name, Email*  
(Name, Email Id, Phone)

**IITB Co-supervisor(s)**  
(Name, Email Id, Phone)

**IITB Department:**

## Research Academy 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](http://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

## The research problem

*There are many examples from Nature of protein active sites which need strictly defined environments in which to function. Classic examples include haemoglobin and myoglobin. Their active sites, ie their haem prosthetic groups, require an environment where a "soft" interaction occurs between the ferrous ion and molecular oxygen. All attempts to mimic this environment are plagued by the irreversible formation of  $\mu$ -oxo dimers. Essentially the globin protein provides a scaffold which prevents dimer formation as well as providing the necessary ligands for function. A similar situation exists with many enzymes. There is still a largely unmet need for chemical mimics for these systems, in spite of an extensive literature on the subject. The self-assembling systems in this proposal are designed to meet this need.*

## Project aims

*The ultimate aim of this project is to design and synthesise self-assembling systems which provide fully functional mimetics of enzymes and other proteins.*

1. *The initial aim will be to prepare a number of porphyrin-containing molecules with appropriately designed helical- $\beta$ -peptide units attached.*
2. *The second aim will be to study factors which promote self-assembly of these molecules, beginning with*

conditions recently published by our group.

3. The third and final aim will be to evaluate the fully assembled systems for function with an initial focus on oxygen-carrying performance.

### **Expected outcomes**

One major outcome from this project will be the development of new chemistry in the synthesis of new, self-assembling helical- $\beta$ -peptides as scaffolds bearing a variety of porphyrin based systems for (a) oxygen transport and (b) catalysis. A second major outcome will be the demonstration of full function of these systems. Overall, once these two outcomes have been achieved, the project will have delivered a new family of self-assembling biomimetic systems with a wide variety of commercial applications.

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

The systems to be prepared in this project will self-assemble into fibres, meshes and gels all based on nanofibres. Thus the project will deliver a new family of nanomaterials with wide application in the fields of nanomaterial science and nanomedicine. The behaviour of these materials, both in their individual character, mode of self-assembly and function once fully self-assembled will increase our understanding of the performance characteristics and requirements of such nanomaterials.

### **Capabilities and Degrees Required**

In order to qualify for this project the candidate will need a solid background in organic synthetic chemistry as well as an eagerness to apply his/her skills to nanotechnology and new materials. A background in coordination chemistry would also be useful although it is not a prerequisite. Also a preparedness to learn some new analytical methods such as AFM, SEM and TEM, is desirable.

### **Potential Collaborators**

I would be keen to collaborate with a variety of scientists at IITB should they be interested in this proposal.

However I can identify now two potential collaborators as: Prof. Krishna Kallippan and Dr Fernandes.

Please provide a few key words relating to this project to make it easier for the students to apply.

**Nanotechnology, self-assembly, biomimetics, organic synthesis, new materials.**