

**Project Title:** Investigating the Feasibility of Adsorption-Based Personal Wearable Cooling Devices

**Project Number** IMURA1028

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### Research Clusters:

### Research Themes:

<b>Highlight which of the Academy's CLUSTERS this project will address?</b> <i>(Please nominate JUST <u>one</u>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>	<b>Highlight which of the Academy's Theme(s) this project will address?</b> <i>(Feel free to nominate more than one. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>
1 <span style="background-color: yellow;">Material Science/Engineering (including Nano, Metallurgy)</span> 2 <span style="background-color: yellow;">Energy, Green Chem, Chemistry, Catalysis, Reaction Eng</span> 3 <i>Math, CFD, Modelling, Manufacturing</i> 4 <i>CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control</i> 5 <i>Earth Sciences and Civil Engineering (Geo, Water, Climate)</i> 6 <i>Bio, Stem Cells, Bio Chem, Pharma, Food</i> 7 <i>Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng</i> 8 <i>HSS, Design, Management</i>	1 <i>Artificial Intelligence and Advanced Computational Modelling</i> 2 <i>Circular Economy</i> 3 <span style="background-color: yellow;">Clean Energy</span> 4 <i>Health Sciences</i> 5 <span style="background-color: yellow;">Smart Materials</span> 6 <span style="background-color: yellow;">Sustainable Societies</span>

## The research problem

### *Define the problem*

Addressing the need for energy usage and cost reduction for comfort cooling. Targeting personal cooling to try and reduce the cooling loads while maintaining the desired comfort. The design of the personal cooler will be wearable. Current evaporative cooling technology requires refilling with water. Use of a nanoporous adsorbent is an interesting alternative that could offer a closed loop solution to heat management.

## Project aims

### *Define the aims of the project*

Initially the project would seek to determine the feasibility of nanoporous materials to meet the predicted performance specifications for personal cooling. A series of candidate materials would be carefully characterised and key factors such as heat capacity, water sorption capacity and adsorption kinetics recovered to allow a feasibility assessment to be made. The student would then return to IITB with a supply of candidate material for use in the prototyping studies.

In the latter stages of the project, down-selected materials would be examined for a prototype wearable device. Targeted cooling will be for 100 to 150 W for 8 h operation with one intermittent charging during lunchtime in order to maintain 21 to 24°C temperature in the jacket to ensure comfort for an office person.

## How skills/experience of the IITB and the Monash supervisor(s) support the proposed project

### *Highlight the purpose of the collaboration and/or the complementary skills/experience that you bring to the project. Do you have any joint or independent publications in the area of the proposed project?*

Prof Rane at the Heat Pump Laboratory at IIT Bombay, HPL\_IITB, has experience in development, demonstration and helping commercialize technologies related to Air Conditioning, Heat Pumps, Renewable Energy and Waste Heat Recovery.

Prof Hill in the Applied Porous Materials team at Monash Clayton is an expert in the synthesis and characterisation of porous materials, he has 140 publications and 17 patents in this area.

## What is expected of the student when at IITB and when at Monash?

### *Highlight how the project will gain from the students stay at IITB and at Monash*

During the stay at Monash the student would have the opportunity to investigate and identify porous materials that may have the potential to operate in the heat pump setting. They would conduct the experiments required to determine feasibility and then

The student can work in the Heat Pump Laboratory at IIT Bombay, HPL\_IITB, where the student will benefit from the vast experience in designing, developing, demonstrating and helping commercialize technologies related to Air Conditioning, Heat Pumps, Renewable Energy and Waste Heat Recovery. This will help in designing the hardware, procuring the material and testing the assembly of the wearable personal cooler.

## Expected outcomes

### *Highlight the expected outcomes of the project*

An assessment as to whether adsorptive based wearable coolers are likely to be feasible.

A techno-economically viable **Wearable Personal Cooler, WPC**

## 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.*

**WPC** will help **reduce the cooling demand and reduce energy consumption** while providing the desired comfort to the wearer in an Office.

**WPC** will help **reduce the need for conventional refrigerants as it is likely to use water and air as the working media** avoiding the ODP and GWP concerns and making the cooling option **Clean and Environment Friendly**.

**WPC** will require fewer resources to integrate and operate. Thus, help **reduce the material and embodied energy associated** while providing the desired comfort.

## 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*

Prof Milind D Atrey, Prof Shankar Krishnan, Prof Arun Kumar Shreedharan

## 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.*

Knowledge and prior experience related to one or more areas amongst Air Conditioning, Adsorption, Porous Material, Comfort Cooling and Personal Coolers will be helpful.

## 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)*

Thermal Environmental Engineering, ME681 and Air Conditioning System Design, ME684.

## Potential Collaborators

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

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