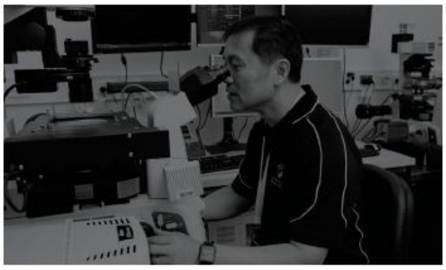

Semiconductor Nanomembranes for Organ-on-Chips, Wearables, and Implantable Applications

Prof Hoang-Phuong Phan
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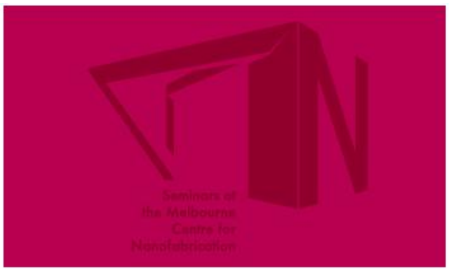
UNSW Sydney, Kensington, NSW 2052, Australia

11:00am, 28/04/2026
Melbourne Centre for Nanofabrication
151 Wellington Road, Clayton, 3168
Zoom link: click here
Meeting ID: 864 5917 5242 and passcode: 168689



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Semiconductor Nanomembranes for Organ-on-Chips, Wearables, and Implantable Applications

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Abstract

Inorganic semiconductors are the key building block for most industrial integrated circuits, from computing processors to laser modules and power converters. Engineering these materials into free-standing nanomembrane architecture enables flexibility and stretchability, opening new avenues for biosensing and biomedical applications that demand mechanical compliance with soft tissues.

This talk highlights our recent efforts to engineer nanomembrane semiconductors, including silicon and silicon carbide, for three classes of biomedical systems: organ-on-chip (for disease modeling and drug screening), wearable (for on-skin monitoring/diagnosis), and implantable devices (for invasive interventions), Figure 1. In the first example, we harness the multiphysics coupling of liquid surface tension and gas compression in nanoscale silicon cantilevers to create biomechanical well plate (BWP) arrays for autonomous, longitudinal monitoring of organoid and engineered heart tissue contractions. In the second, we integrate silicon cantilever chips with wireless, flexible circuitry to realize a miniaturized auscultation patch (AusculPatch) – recently patented technology for home-based health monitoring. This platform captures vital body sounds including respiration, pulse waves, heart sounds, and vocal cord vibrations, supporting the diagnosis of conditions such as valvular disease and sleep apnea. In the third, we advance transfer printing techniques for wide bandgap semiconductor membranes (e.g., SiC), enabling long-term implantable electronics such as robust biobarriers, stimulation electrodes, and strain sensors.

Together, these technologies establish a toolkit of semiconductor-based platforms that accelerate the transition away from animal models, enable telehealth solutions, and support chronic disease management.

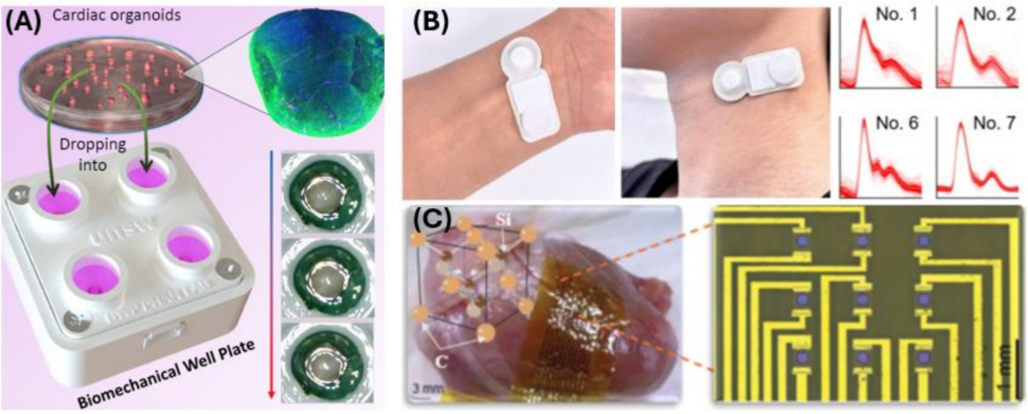
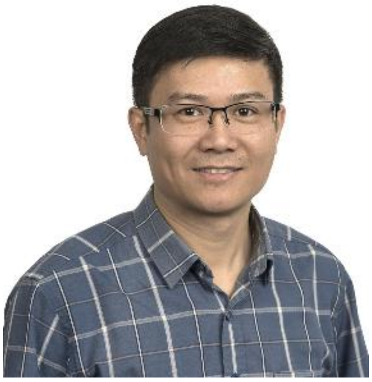


Figure 1. Examples of engineered nanomembrane technologies from the Intelligent Microsystem Lab – UNSW. (A) A wireless organ-on-chip platform for cardiac organoids. (B) A flexible wearable acoustic patch. (C) Implanted electrodes arrays using silicon carbide.

Biography



Hoang-Phuong Phan is a Scientia Associate Professor and an ARC Future Fellow at the School of Mechanical and Manufacturing Engineering at UNSW Sydney. He received his B.E. and M.E. degrees from The University of Tokyo, Japan (2011, 2013), and his Ph.D. from Griffith University, Australia (2016). Phan is current the Head of the Intelligent Microsystem Laboratory, focusing on MEMS/NEMS, integrated sensors, flexible electronics, and three-dimensional micro-architectures. Prof. Phan has held visiting postdoc appointments at XLAB, Stanford University in 2017 (USA), and the John Rogers Resarch Group, Northwestern University in 2019 (USA). He has authored over 160 journal papers in leading journals including Nature Communications, Science Advances, PNAS, Science Robotics, ACS Nano, Advanced Functional Materials, Angewandte Chemie, and Nano Energy, along with 3 patents and 5 book chapters. Phan has received several awards such as Springer Outstanding Thesis Award, the ARC DECRA Fellowship, Griffith Vice-Chancellor's Excellence in Research Award, UNSW GROW Award, the ARC Future Fellowship, and the Scientia Fellowship.

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