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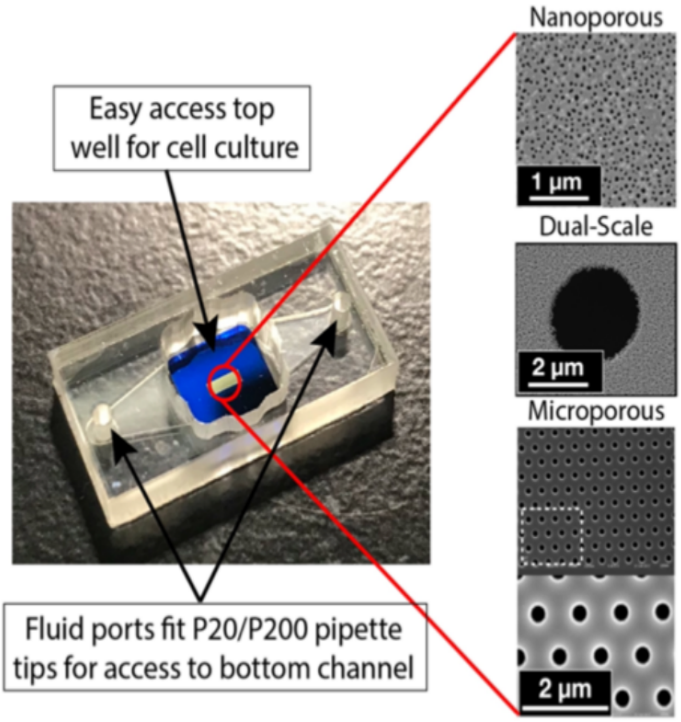
OPTICS & PHOTONICS
UNIVERSITY OF NOTTINGHAM

Optics and Photonics Group Lunchtime Seminar

"The Benefits of Being Thin: How Ultrathin Silicon Membranes are Enabling New Technologies for Discovery in Biomedical Research"

Prof Jim McGrath

University of Rochester



14:00 Wednesday 26 April 2023
Boots Building - B34
All Welcome

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MS Teams link

Now more than a decade after we first used silicon microfabrication to create free-standing ultrathin nanoporous membranes, the materials are realising their potential to impact multiple disciplines. Today, we manufacture and apply a variety of nanoporous and microporous membranes with the common characteristics that they are ultrathin (15 nm - 300 nm) and made from silicon-containing materials. Because these 'nanomembranes' are orders-of-magnitude thinner than conventional membranes, they are orders-of-magnitude more permeable to both diffusing molecules and pressurized flow. Molecular scale thickness also enhances the resolution of separations when the membranes are used as sieves. High permeability and high-resolution sieving, as well as other expected and unexpected characteristics of nanomembranes, have sparked research programs on topics as disparate as hemodialysis and sensing. This talk will briefly review our progress in establishing the basic science of ultrathin nanoporous and microporous membranes. Through modelling and experimentation, we have developed a fundamental understanding of convective and diffusive flows, sieving behaviour, fouling, membrane mechanics, and electrokinetic phenomenon. I will then discuss two particularly promising applications of nanomembranes: 1) as tools that enable unique approaches to diagnostics and 2) as platforms for the construction of in vitro models of human tissue. In diagnostic applications, nanomembranes are being used as both pre-filters and concentrators that improve the performance of other sensors, and as digital ('single entity') detectors. In 'tissue chips,' nanomembranes are being used to create in vitro models of blood-brain-barriers (BBB) for sepsis and multiple sclerosis, to model tendon healing after injury, and as screens to discover essential genes, and therapeutics to prevent, staphylococcus aureus infection of cortical bone.