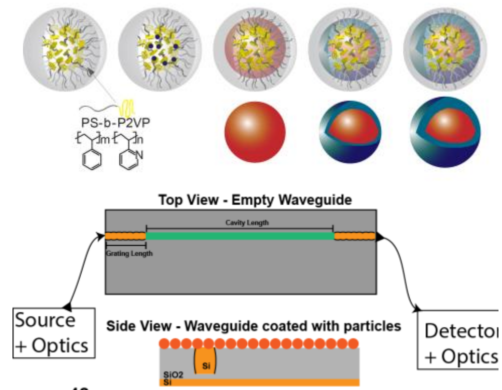
TURAK RESEARCH GROUP

MSc and PhD positions (Fall 2023/Winter 2024)
Magnetic core-shell nanoparticles for optical isolation in photonic networks
Department of Physics, Concordia University, Montreal Canada
Centre for NanoScience Research (CeNSR)

The Turak Functional Nanomaterials Laboratory seeks to revolutionize photonics by making them cheaper, more accessible, and more flexible. Our research focusses on developing easy, versatile, and inexpensive methods of exploring and tuning surfaces using nanoparticle functionalization. To achieve this vision, the Turak group uses simple manufacturing approaches (reverse micelle deposition), allows nature to dictate morphology (entropic self-assembly, beneficial dewetting), and develops characterization tools that are widely applicable to nanotechnology.



Lewis, Turak et al. J. Mater. Science: Mat. Elect. (2023)

The world's appetite for data is growing exponentially, driven by Internet applications such as social networks and streaming media and newly emerging "Internet of Things" applications, including smart homes and offices. But this increased data use comes at a steep energy and time cost, driven by the need to charge and discharge electrons to move data, and to cool those systems to keep them running effectively. Photonics-based electronics, which rely on light use less energy and can transmit data faster than conventional approaches, but the costs and scalability of manufacturing silicon integrated circuits with embedded photonic elements have held back progress in recent years. One of the key missing components is an embedded on-chip optical isolator, which can prevent back-reflections that lead to noise and instability in photonics circuits. Optical isolators only allow light to propagate in one direction, taking advantage of light polarization through the manipulation of a magnetic field.

In the proposed project, the student will develop and test metal-metal oxide core-shell magnetic nanoparticles using the reverse micelle deposition (RMD) technique to incorporate into silicon waveguide to act as optical isolators. RMD is a solution-based approach that allows for cheap and simple incorporation of complex nanoparticles as part of a Si integrated light circuit. Both the intrinsic magnetic properties of the nanoparticles and their effectiveness as an optical isolator will be assessed. The Faraday rotation due to the particles will be determined, and the impact on light propagation as part of pre-etched waveguides will be determined. The student will optimize the nanoparticle recipe for maximized magneto-optical properties, compared with those predicted in simulation. They will use AFM, SEM, XRD and XPS to confirm the formation of single crystal nanoparticles, and SQUID and ellipsometry to determine the magnetic and optical properties.

Concordia Department of Physics is a growing department in a university with rapidly increasing rating. We offer research-based M.Sc. and Ph.D. programs. Our faculty members conduct research in the areas of Condensed Matter Physics (theoretical and experimental), Molecular Biophysics, Medical Physics / Imaging, Photonics, Theoretical High Energy Physics, Computational Physics and Physics Education.

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Successful applicants will be offered financial packages consisting of RA, TA and various awards of at least 20,000 CAD per year (often more), for 4 years (Ph.D.) or 2 years (M.Sc.). International students will be offered tuition remissions or other awards to compensate for the international tuition fees.

To apply, please send a letter of interest, CV and contact information for two references in a single pdf document, with email subject “Turak Lab Project Applicant”. Only applicants considered for employment will be contacted for an interview. **All applications should be sent to Ayse Turak (ayse.turak@concordia.ca)**