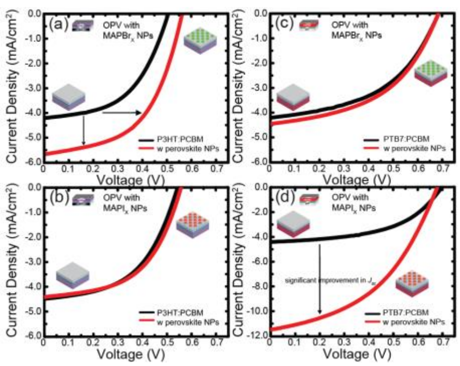
TURAK RESEARCH GROUP

Undergraduate research opportunity (Summer 2023/Fall 2023/Winter 2024)
Organo-halide perovskite-based nanoparticles for photovoltaic applications
Department of Physics, Concordia University, Montreal Canada
Centre for NanoScience Research (CeNSR)

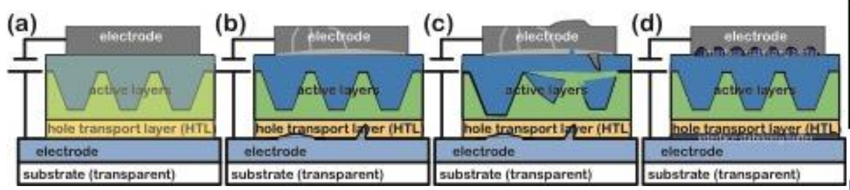
The Turak Functional Nanomaterials Laboratory seeks to revolutionize optoelectronics by making them cheaper, more accessible, and more flexible. Our research focusses on developing easy, versatile, and inexpensive methods of exploring and tuning surfaces using nanoparticle functionalization. To achieve 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.



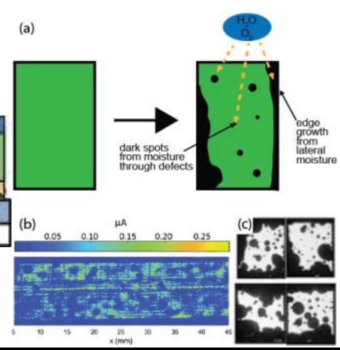
M. Munir, Turak *et al.*, Adv. Photonics Res. 3 2100372 (2022)

With a potential global market of $134 billion by 2020, solar cells are one of the most promising approaches to alternative energy. Any effort to make solar products cheaper, more accessible, and more flexible will have a huge impact on the way people use clean energy. Among solar technologies, semiconducting organic molecules and perovskites (organic/ hybrid photovoltaics or H-OPVs) are one of the most versatile and promising approaches. However, the adoption of H-OPVs depends on resolving current technological obstacles: short lifetimes, exacting manufacturing requirements, and specifically for OPVs, low efficiencies. A particular concern for solar applications is the photo-instability of many organic and perovskite materials, as well as their susceptibility to oxygen and water degradation. A novel approach to stabilizing organic and hybrid perovskite materials is to form core-shell nanoparticles, which generally show an enhanced stability toward light and oxygen compared to isolated molecules.

In the proposed project, the student will apply the reverse micelle deposition technique to produce core-shell perovskite nanoparticles from solution. These films will incorporated into solution deposited solar cells, produced in the custom integrated glovebox facility in the Turak Laboratory. The dispersion of the various nano particles will be tuned to have the same current density and internal electric field, as determined by electrostatic force microscopy or electrochemical measurements. Accelerated aging of devices will be done using a unique humidity controlled environmental testing chamber, custom



Turak *in* Handbook of Organic Materials for Electronic and Photonic Devices (2019)



7141 Sherbrooke Street West, Montreal, Quebec, Canada H4B 1R6 Tel.: 514 848-2424 ext. 3276 Fax: 514 848-2828 http://physics.concordia.ca

built in the Turak Lab, to examine the loss of power conversion efficiency over time. The student produce solar cells based on ITO/PEDOT:PSS/active-layer/Al comparing the nanoparticle films to traditional spin coated versions as the active layer, examining the IV characteristics under illumination.

Students interested in paid (USRA, CURSA, Physics URA, FRQS Awards for Undergraduate Introduction to Research), for class credit (Honors thesis or research experience) or volunteer internships from Physics, Chemistry, Chemical and Materials Engineering, or related areas are welcome to apply.

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)**