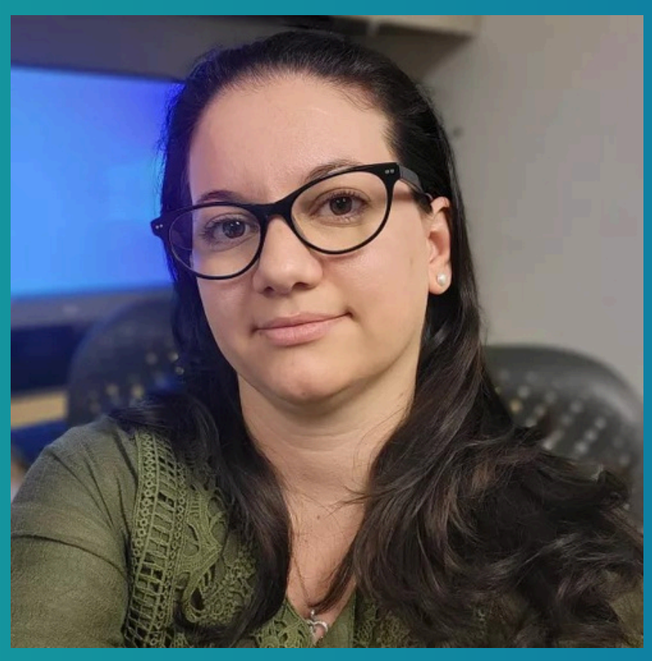
Chemical & Physical Sciences
UNIVERSITY OF TORONTO
MISSISSAUGA

Colloquium Seminar Series
Wednesday, October 2, 2024
3:15PM in CC3150

Electrochemical sensing of drugs in saliva for police roadside testing: from the lab to the first prototype



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In Canada, drug-impaired driving poses a significant threat to road safety, with a higher percentage of drivers killed in vehicle accidents testing positive for drugs than for alcohol. Nevertheless, Δ^9-tetrahydrocannabinol (THC) is the most psychoactive component of Cannabis. On the other hand, saliva has become increasingly popular as a biological medium for drug testing. Furthermore, some countries have established the confirmatory cut-off values in saliva from 0 (zero tolerance) to 2 ng/mL, 5 ng/mL, or 10 ng/mL for driving under the influence of a THC drug.

Herein, a novel biomolecule-free electrochemical approach to detect an ultra-low level of THC in saliva using modified electrodes is presented. Challenges during the construction of the sensor are discussed such as saliva composition, sample-to-sample variations, coexisting analytes (cannabidiol, CBD) with similar structures as interferences, stability of the sensor, bath-to-batch electrode variations, and so on. This novel yet simple electrochemical-based sensing strategy allowed for a low limit of detection of 1.6 ng/mL THC in simulated, distinguishing concentrations ranging from 2 to 25 ng/mL, making this technology viable for a real-world application such as roadside testing. Other attractive benefits of the proposed design and methodology included a short duration for the test (38 s), cost-effective and straightforward manufacturing, drop-size sample volumes, portability, and easy handling in field conditions.

Due to variations in person-to-person saliva and potential CBD/THC interferences, the traditional analysis of calibration curves by plotting analyte concentrations versus response current values led to unacceptable results. Therefore, Machine Learning algorithms were introduced to analyze real saliva datasets to overcome these setbacks. Overall, the classification of THC (CBD) samples with 0, 2, and 5 ng mL−1 presented the best performance, with accuracies approaching 92% and 83% for testing.

Astrophysical Tests of Dark Matter

Hubble Deep Field

Dark matter (DM) makes up more than 80% of the matter in our universe, but we have no idea what it is or where it comes from. In this talk, I will review some of the evidence for the existence of DM and highlight one particularly plausible explanation: a new class of particles called ultralight axions. These ultralight axions arise naturally from string theory and have masses so low that their de Broglie wavelength smooths out cosmic structure on galactic scales. I will then present some of my recent work using the UV luminosities of high-redshift galaxies (as measured by the Hubble and James Webb space telescopes) to test models of ultralight axions, setting limits on their particle mass and DM fraction.

Harrison Winch
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