Faculty of Engineering and Applied Science
Chemical Engineering Seminar Series

Queen's University

Inebriated electrochemistry: Recent advances in materials for electrochemical breath alcohol sensing

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Dupuis Hall, Room 215

ABSTRACT

Breathalyzer devices are widely used by law enforcement officers world-wide. The most common devices used for roadside screening employ electrochemical breath alcohol sensors (BrAS). Current state-of-the-art BrAS technology is based on a membrane-electrode assembly (MEA) that employs a porous polyvinyl chloride (PVC) membrane filled with H_2SO_4 (aq). Each electrode contains massive amounts of Pt black catalyst (~10 - 20 mg/cm^2) and a Teflon binder. The market for these devices is growing rapidly in large part due to the adoption of alcohol ignition interlocks for offenders, new OEM automotive safety requirements, and the growing popularity of consumer-grade personal breath testers. As such, substantial cost reduction is needed to improve economic viability and OEM cost targets.

Despite its commercial success over the last 3 decades, electrochemical BrAS have been sparsely studied in the academic literature. Very little is known about how electrode structure influences sensor performance. Furthermore, environmental conditions are known to influence sensitivity and operational lifetime, yet the mode of degradation is not well understood.

Since these devices closely mimic fuel cell technology from three-decades ago, our approach to BrAS has been to adapt materials and methods initially developed for power generating fuel cells. In this presentation, I will describe how we developed new MEA compositions that employ 97% less Pt but can still achieve sensitivity that is on-par with current BrAS commercial technology. Likewise, I will describe how chemical modification of the electrocatalyst materials can yield enhanced sensitivity and/or stability. This, coupled with *in situ* electrochemical diagnostic measurements, allow us to gain new insights into how sensitivity and durability are related to electrode composition and water retention.

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