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A novel, ultra-fast, robust microelectrodes for real-time detection of heavy metals using fast-scan cyclic voltammetry

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Humans are highly vulnerable to being exposed to multiple sources of arsenic and cadmium, such as drinking water, foods, inhalation, and occupational means. The detrimental effects of arsenic and cadmium poisoning are well documented. Electrochemical sensors are more attractive over other analytical tools available for metal detection mainly due to the excellent selectivity, sensitivity, cost, and ease of use by a non-expert in the field. Interestingly, the reported electrochemical sensors for As^{3+} and Cd^{2+} in aqueous samples have been primarily performed with gold-based electrodes or other surface-modified electrode materials such as glassy carbon due to their enhanced sensitivity. However, the fabrication process of these electrodes is complex and expensive. Furthermore, most of these experiments were conducted in extreme pH conditions. Although the data obtained with environmental samples are promising, these tools are not suitable for *in vivo* detection of low concentrations of metals, particularly in the brain, and cannot perform fast measurements. Therefore, in this study, we developed a novel, ultra-fast, and robust electrochemical sensor that can perform real-time detection of As^{3+} and Cd^{2+} with a temporal resolution of 100 ms. Our electrode is fabricated with carbon-fibers, thus making an excellent biocompatible sensor for future *in vivo* studies. We performed our electrochemical measurements with cutting-edge electrochemical technology, fast-scan cyclic voltammetry. We optimized electrochemical parameters (potential window, resting potential, and scan rate) to generate unique cyclic voltammograms to identify As^{3+} and Cd^{2+} at a sub-second temporal resolution. Interestingly, we show that we can measure As^{3+} in the ambient air. We also performed calibration studies, selectivity, and stability studies to evaluate our novel metal sensors. Our preliminary data showcases the power of our tool as an excellent environmental sensor that can detect these two metal ions in aqueous samples. More importantly, these data indicate a great potential for developing this device to perform real-time *in vivo* measurements of metals in the brain.

Keywords: As^{3+}, Carbon-fiber, FSCV, Metals, Ultrafast

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