# Electronically Controlled Delivery of Kynurenic Acid via PEDOT Functionalized Carbon Nanotube Coatings

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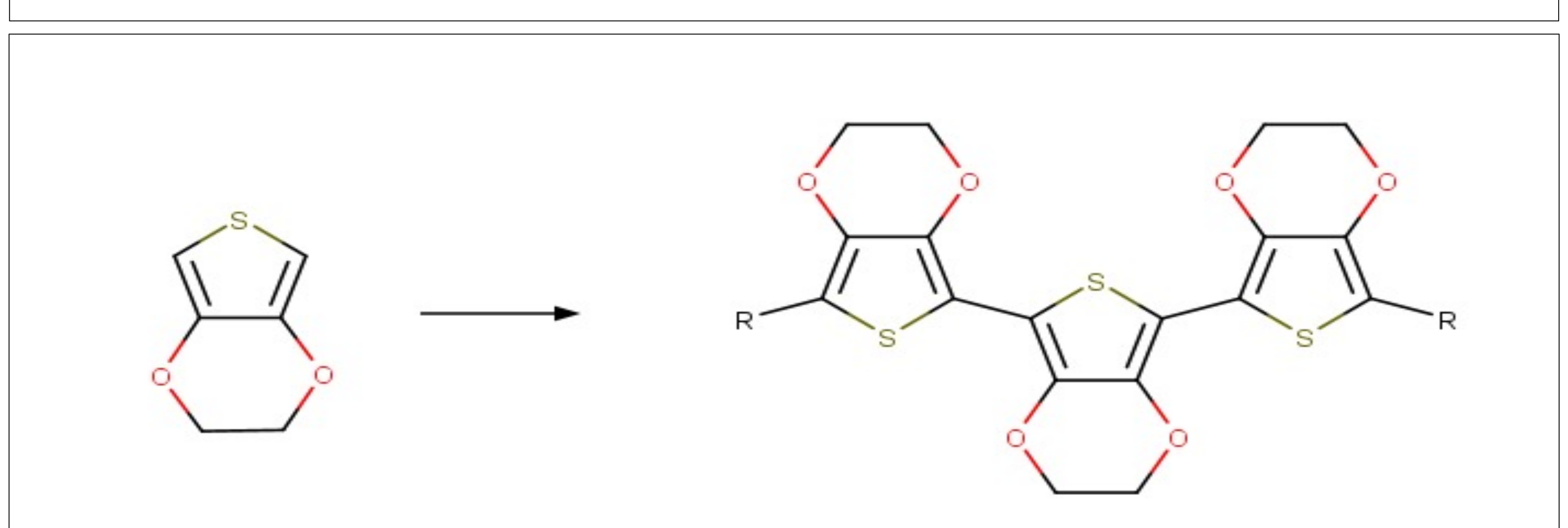
## Abstract

Kynurenic Acid is a known antagonist to glutamate receptors in the brain, which allows for the regulation of dopamine. However, in order to deliver KYNA into the brain, large probes have to be employed which can unfortunately result in a great deal of harm. The field of controlled drug release has promise as an answer to this problem. A coating of poly(3,4-ethylenedioxythiophene) functionalized carbon nanotubes has been shown to increase selectivity and sensitivity for detection of resting DA. We are interested in the ability of the PEDOT/CNT coatings to be loaded with KYNA, which can then be released. We successfully optimized the PEDOT/CNT coatings on glassy carbon electrodes, as shown by a decrease in impedance and increased charge storage capacity. KYNA loading is performed via copolymerization as a new, PEDOT/CNT-KYNA coating is synthesized. Controlled release will be performed via voltage stimulation and then quantified using high performance liquid chromatography.

## Methods

- Carbon nanotubes (CNTs) functionalization
- EDOT/CNT polymerized to glassy carbon electrodes to form PEDOT/CNT coating (scheme 1)
- Sonication time optimization
- Detection of dopamine via square wave voltammetry
- Detection of Kynurenic Acid
    - Detection with fluorescence spectroscopy
    - Detection with HPLC




Scheme 1: The polymerization of EDOT to PEDOT. Polymerization was performed using chronocoulometry at 0.9 V until a predetermined charge cutoff was reached.

## Data and Results

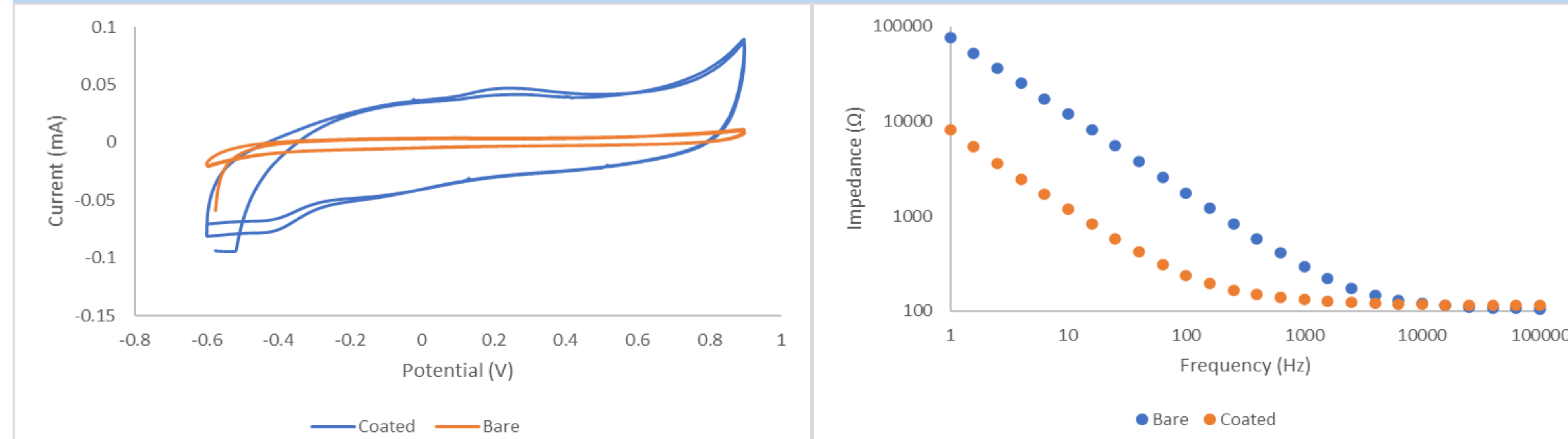



Figure 1: cyclic voltammograms and electrochemical impedance spectroscopy data comparing uncoated and coated glassy carbon electrodes. The coated electrode shows a much larger area and a much lower impedance then the uncoated electrode.

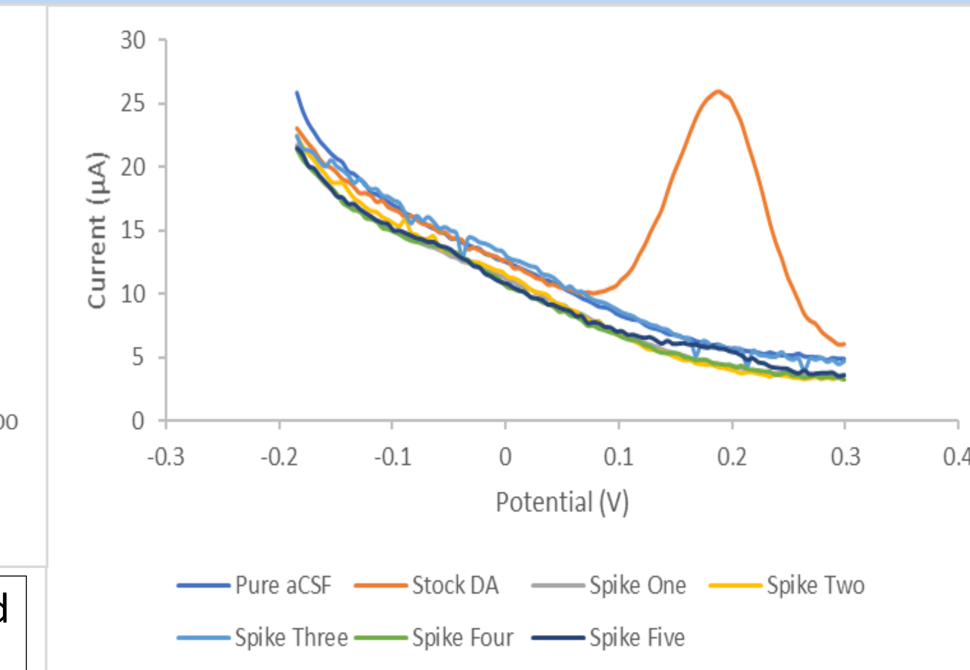



Figure 3: current generated for detection of dopamine with SWV and various dopamine concentrations. The only solution to generate a significant peak was the stock DA solution.

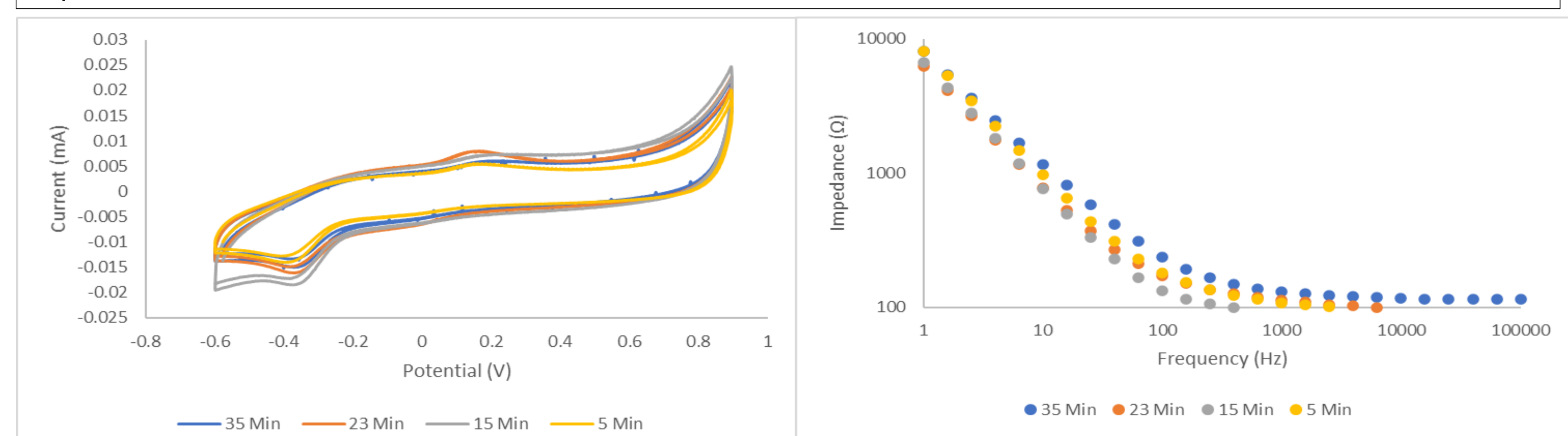



Figure 2: CV and EIS data comparing the effects of sonication time on charge storage capacity and impedance for coated electrodes. The 15-minute sonication showed the largest increase in storage capacity and largest decrease in overall impedance for the glassy carbon electrode.

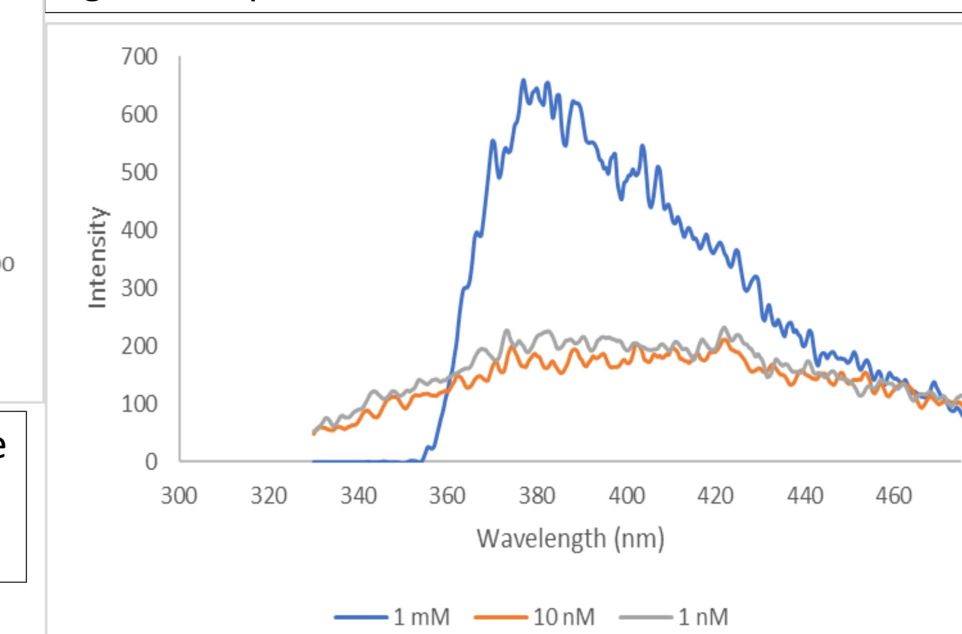
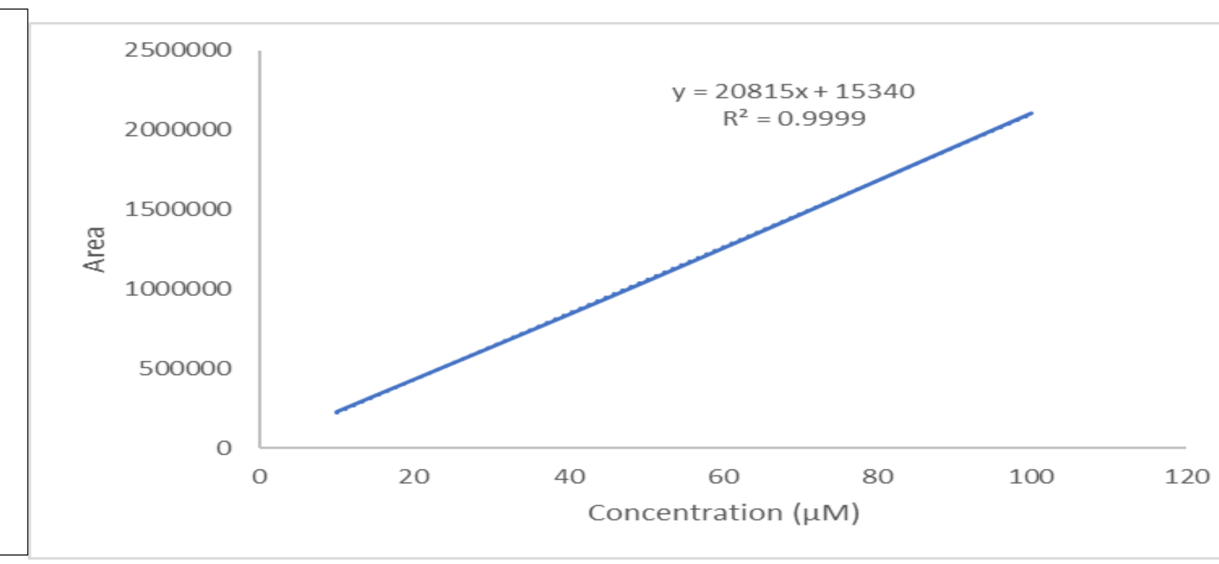



Figure 4: Fluorescence emission spectra for kynurenic acid at various concentrations. Nano molar concentrations were unable to generate a distinguishable peak for KYNA.

Figure 5: Calibration curve generated for the HPLC detection of kynurenic acid. Single digit micro molar concentrations of KYNA were unable to generate a measurable signal, which makes sense as the LOD of was determined to be ≈ 2 µM.




## Conclusions

- Functionalization of carbon nanotubes was successful, as well as polymerization of the PEDOT/CNT coating onto the electrode.
- An optimized sonication time was determined to be 10 minutes in order to maximize coating's performance and efficiency of preparation.
- Dopamine detection failed at low concentrations as PEDOT/CNT coated glassy carbon electrodes are not sensitive enough, aligning with previous data.
- Fluorescence spectroscopy was not sensitive enough to detect kynurenic acid at concentrations in the nano molar range.
- HPLC was then used to construct a calibration curve, and the limit of detection for HPLC analysis of kynurenic acid was determined to be ≈ 2 µM.

## Acknowledgments

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