LOW CURRENT MEASUREMENTS WITH BASI RESEARCH PRODUCTS FARADAY CAGE

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To assess the noise level in the BASi Faraday Cage, cyclic voltammetry and chronoamperometry were performed with a PalmSens4 potentiostat/galvanostat using a platinum microelectrode (d = 10 µm) as working electrode inside and outside of the Faraday cage. The noise assessment[1] on current measured inside the Faraday cage reveals a detection limit of ~50 pA which can be possibly further decreased by proper grounding and isolation of the Faraday cage and potentiostat. The data below outlines the capabilities of the BASi Faraday cage to be used for low current (sub nA) measurements.

CYCLIC VOLTAMMETRY

2.5 and 1 mM solutions of hexacyanoferrate (II) were prepared in 250 mM KCl in Milli-Q Water (18.2 MΩ/cm) and bubbled with N_2 for 5 minutes before measurements. Voltammetry was taken with the platinum microelectrode (d = 10 µm) as the working electrode, a BASi Ag/AgCl reference electrode connected by a salt bridge (1 M KCl suspended in agarose), and a BASi platinum wire counter electrode. A picture of the experimental set-up can be seen in **Figure 1**. Voltammetry was run from -0.25 to 0.75 V at a scan rate of 50 mV/s and a sample interval of 1 ms. Voltammetry was run in both solutions (2.5 (**Figure 2A**) and 1 mM (**Figure 2B**) hexacyanoferrate (II) outside (red traces) and inside (black traces) of the Faraday cage. A clear reduction in noise can be seen after the voltametric set-up was placed in the Faraday cage.

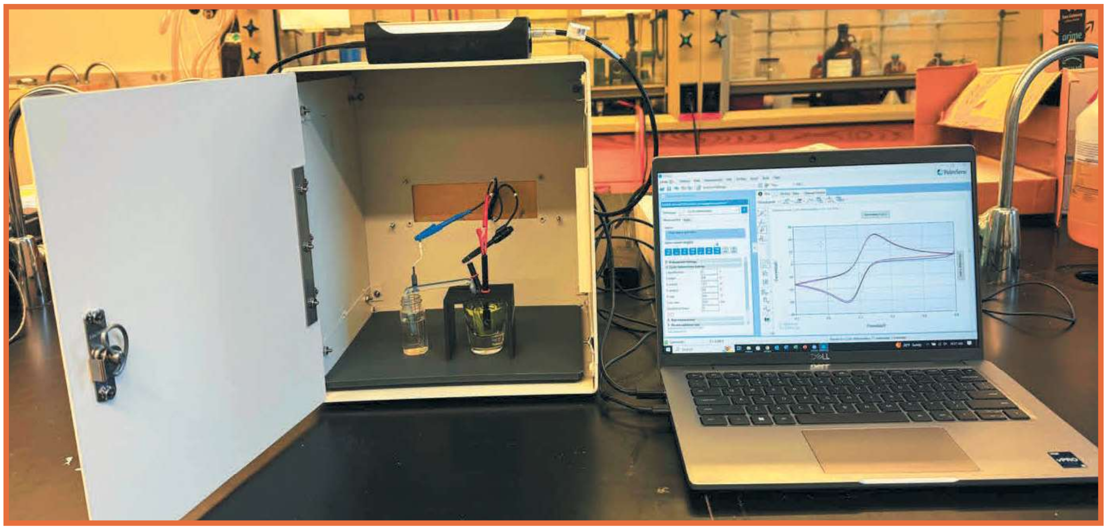

Figure 1. Photograph of experimental set-up. Faraday cage was closed when actual measurements were performed.

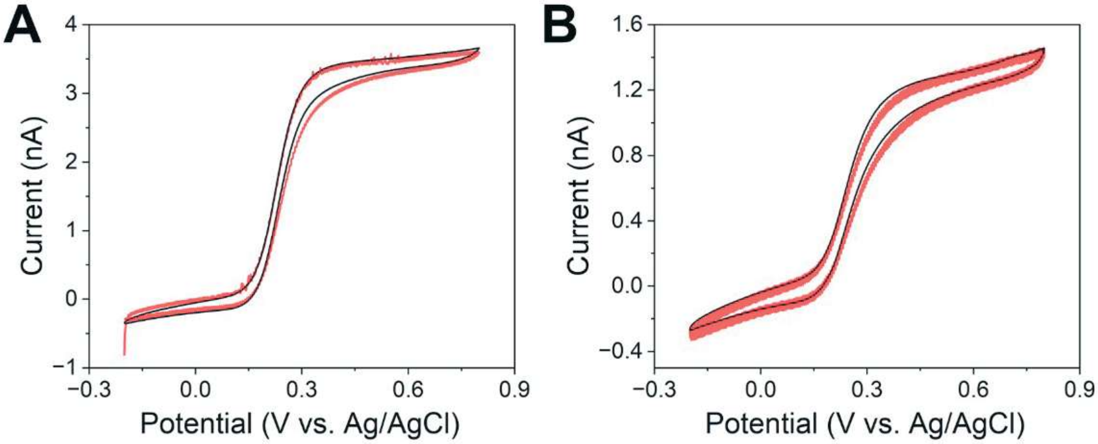

Figure 2. Cyclic voltammograms taken in 2.5 (A) and 1 (B) mM hexacyanoferrate (II) in 250 mM KCl solutions bubbled with nitrogen. Voltammograms were taken inside (black traces) and outside (red traces) of a BASi Faraday cage at a scan rate of 50 mV/s and a sample interval of 1 ms. All voltammograms taken with a platinum ultramicroelectrode (d = 10 µm) working electrode, a platinum wire counter electrode, and an Ag/AgCl reference electrode. Voltammetry plotted in IUPAC convention.

CHRONOAMPEROMETRY

A solution of 250 mM KCl was prepared in Milli-Q water (18.2 MΩ/cm). Chronoamperometry was taken with the same set-up mentioned above. Chronoamperometry was run for 100 seconds in this solution at 0 V with a sample interval of 1 ms both inside and outside of the Faraday cage (**Figure 3**). The overlay of the two traces show a drastic decrease in noise from chronoamperometry preformed inside the Faraday cage and outside of the Faraday cage. Chronoamperometry was run for another 3 replicates both inside and outside of the Faraday cage. (**Figure 4**). The noise level of the replicate measurements within the Faraday cage was assessed by subtracting the absolute value of the current at all points taken from 98-100 seconds (2000 points) by the absolute value of the average current. Once the noise level was determined at each of the points, the overall noise for each replicate was determined from the mean value of all points. A table with the mean current values for each replicate along with the associated standard deviation can be seen in **Table 1**. Based on the noise analysis, the average noise level was ~16 pA across the three replicates. If we define the minimum detectable current as three times this noise level, the Faraday cage allows for the detection of currents as low as ~50 pA.

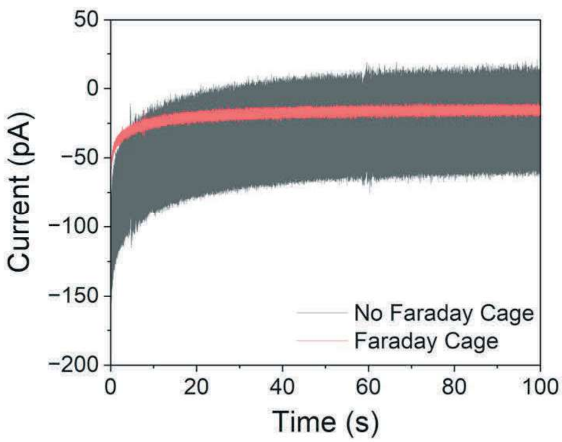

Figure 3. Representative chronoamperograms taken at 0 V vs. Ag/AgCl in 1 M KCl on a platinum ultramicroelectrode (d = 10 µm) at a sample interval of 1 ms inside (red trace) and outside (black trace) of a BASi Faraday Cage.

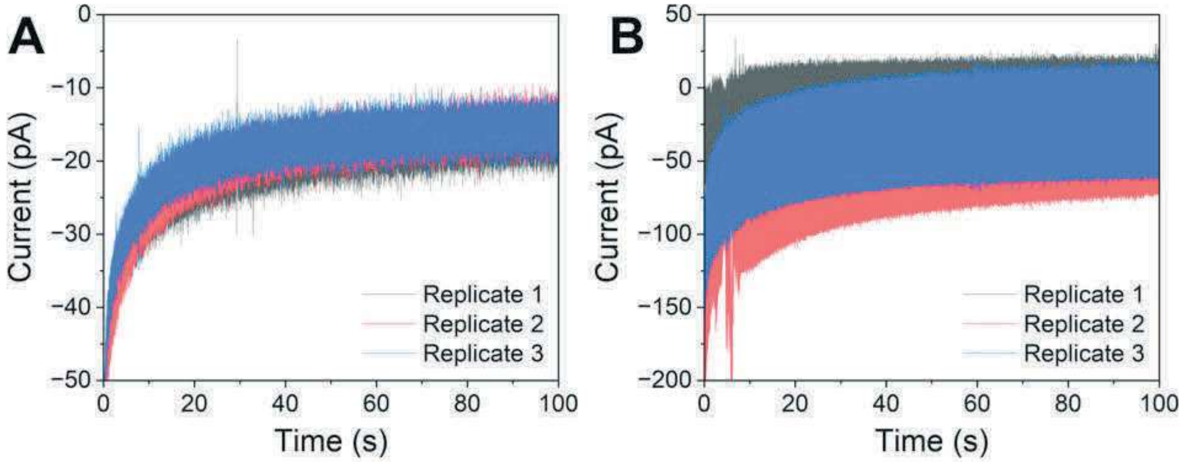

Figure 4. Replicate chronoamperograms taken at 0 V vs. Ag/AgCl in 1 M KCl on a platinum ultramicroelectrode (d = 10 µm) at a sample interval of 1 ms insie (A) and outside (B) of a BASi Faraday Cage.

Replicate Number	Average Noise (pA)	Standard Deviation (pA)
1	17	2
2	15	2
3	16	2

Table 1. Average noise level of the three replicate chronoamperometry experiments with associated standard deviation. The last 2000 data points of each chronoamperogram was used for noise analysis.

REFERENCES

1. Selecting an Optimal Faraday Cage To Minimize Noise in Electrochemical Experiments Matthew W. Glasscott, Eric W. Brown, Keirstin Dorsey, Charles H. Laber, Keith Conley, Jason D. Ray, Lee C. Moores, and Anton Netchaev. *Analytical Chemistry* 2022 *94* (35), 11983-11989 DOI: 10.1021/acs.analchem.2c02347