Setup Guide For Squidstat Potentiostats as a Bipotentiostat for Rotating Ring-Disk Electrode (RRDE) Experiments

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Preface

This application note explains the general use of two Squidstat potentiostats in a bipotentiostat configuration.

- Cyclic voltammetry is collected at the disk while collecting chronoamperometry data at the ring.
- Rotator speed is set manually.

Outline

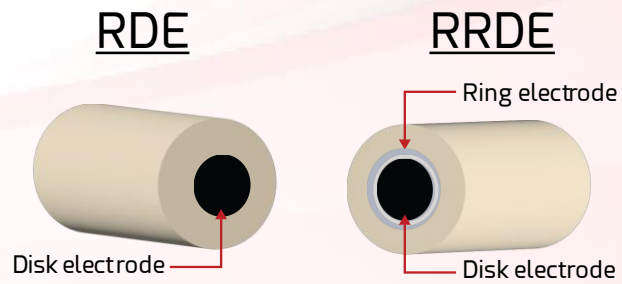
Abbreviations

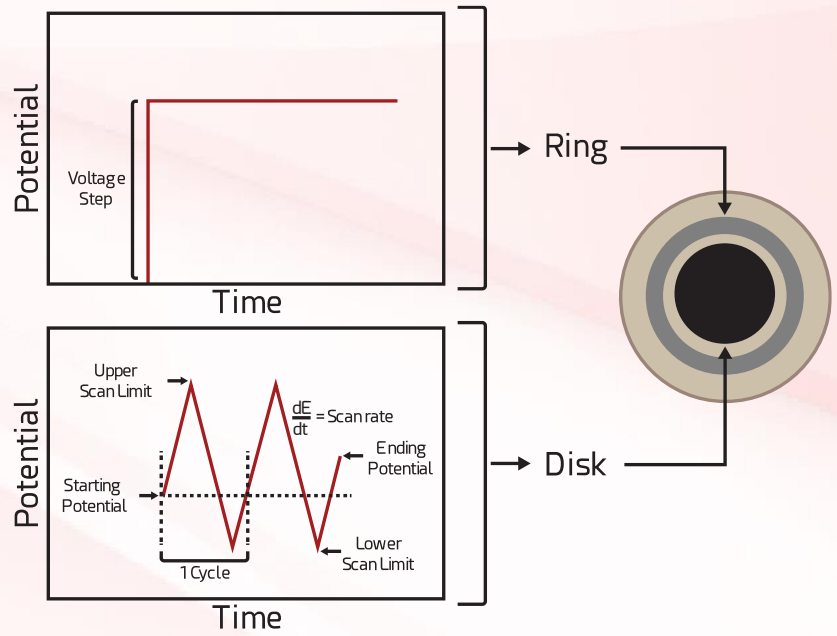
- Counter Electrode – **CE**
- Counter Sense Electrode – **CSE**
- Reference Electrode – **RE**
- Working Electrode – **WE**
- Working Sense Electrode – **WSE**
- Open Circuit Potential – **OCP**
- Rotating Ring-Disk Electrode – **RRDE**
- Squidstat User Interface – **SUI**

Step By Step Guide using Two Squidstat Instruments as a Bipotentiostat with Prebuilt RRDE Experiments

General Step-By-Step Guide

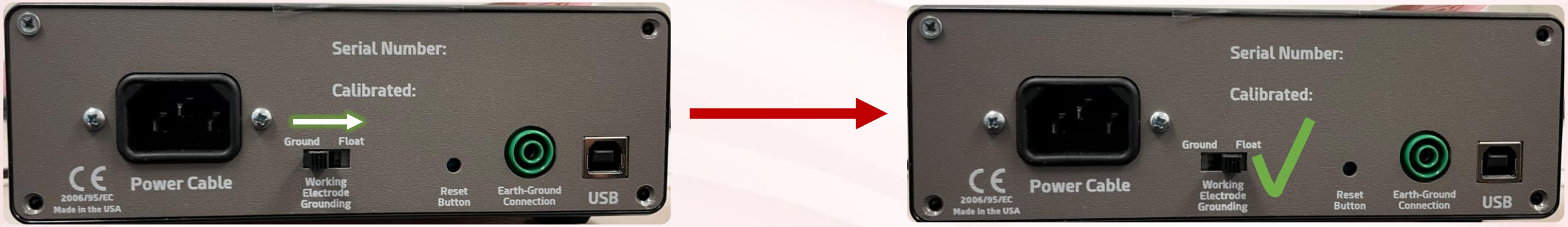
1. Set both instruments to float mode
2. Connect all four counter electrode leads
3. Connect both reference electrode leads
4. Connect two working electrode leads (**Potentiostat A**) for disk, connect two working electrode leads (**Potentiostat B**) for ring
5. Final Standard Configuration
6. Open RRDE pre-built experiment in SUI
7. Select **Potentiostat A** for disk and set potential limits for cyclic voltammetry experiment at disk
8. Select **Potentiostat B** for ring and set constant potential value for ring, start experiment
9. Set save location and begin data collection



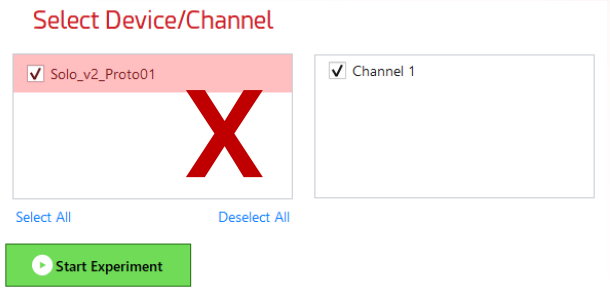


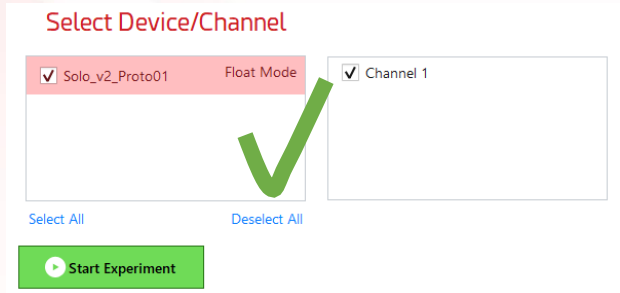
1. Set both instruments to float mode

- On the back of each instrument is a toggle switch to set the hardware to "Float" or "Ground" modes
- Move the switch to the "Float" mode position on **both** instruments



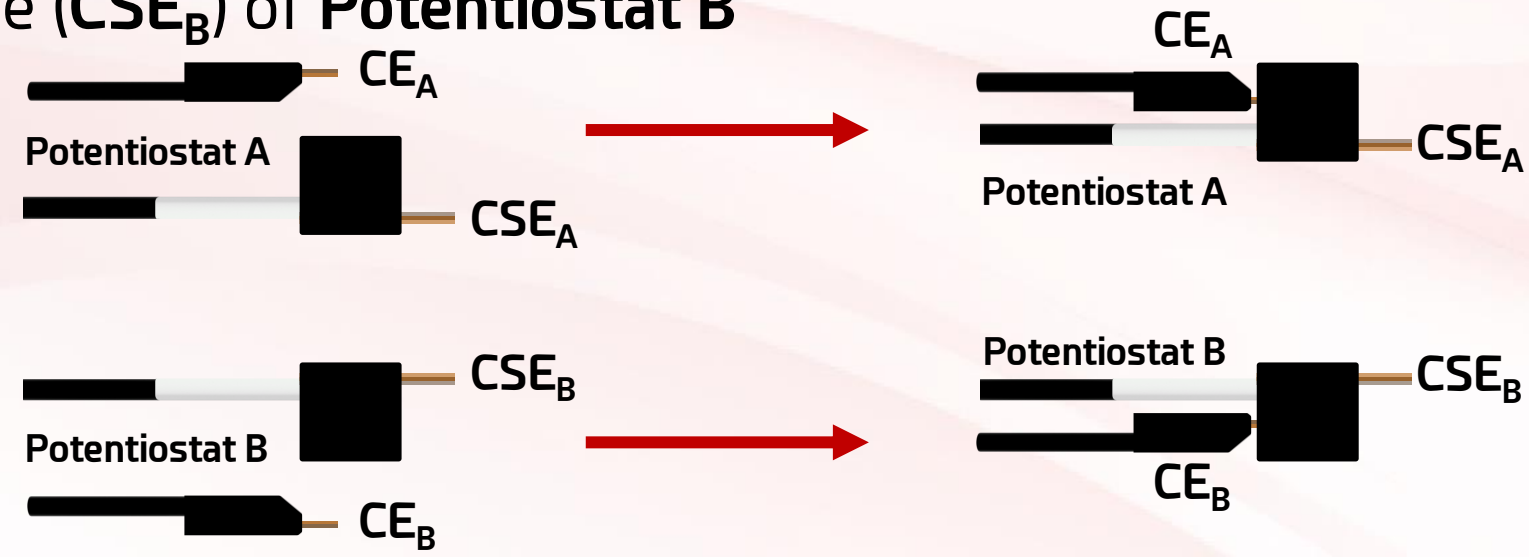
- The SUI software will show that the instrument has indeed been switched into float mode

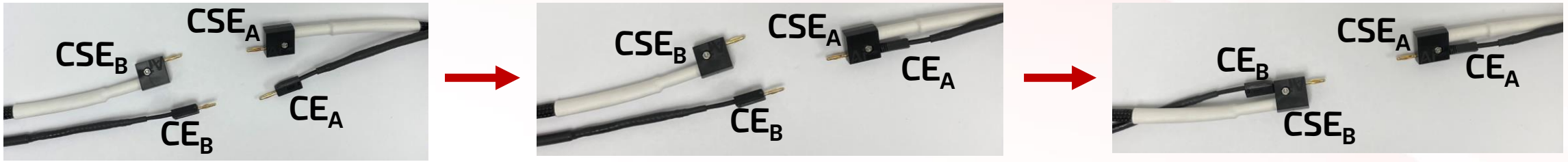




2a. Connections – Counter Electrodes

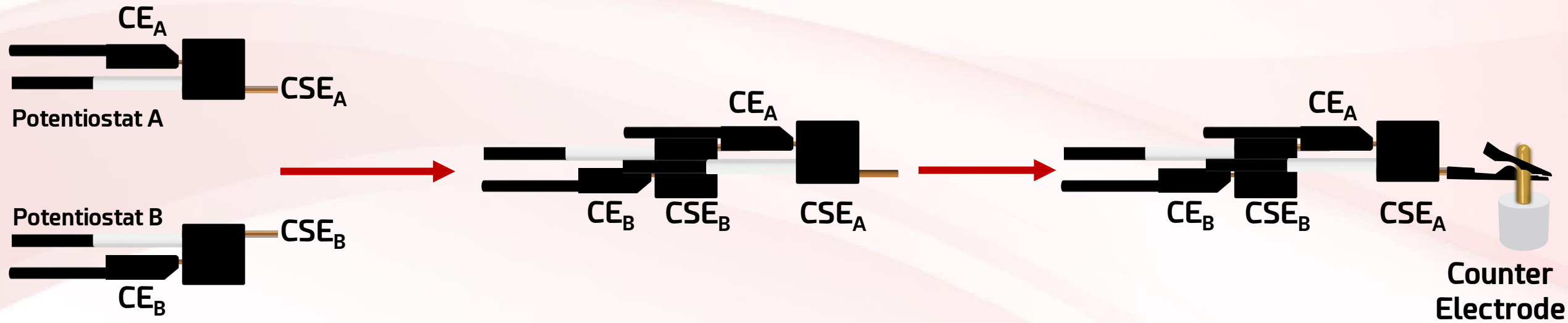
- Insert the counter electrode (CE_A) of **Potentiostat A** into the back of the counter sense electrode (CSE_A) of **Potentiostat A**
- Insert the counter electrode (CE_B) of **Potentiostat B** into the back of the counter sense electrode (CSE_B) of **Potentiostat B**





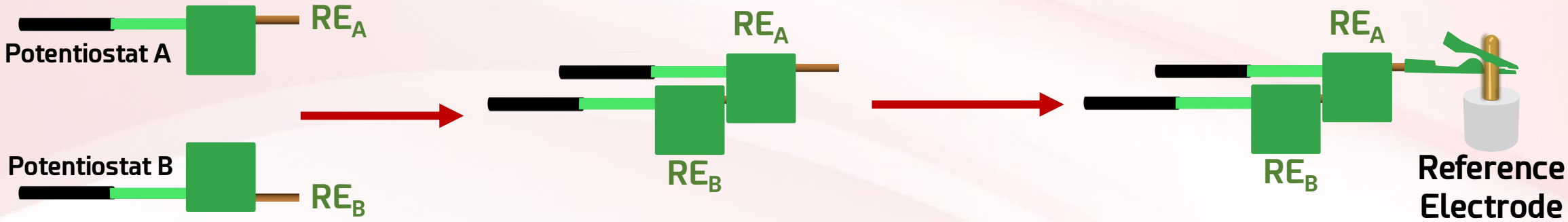
2b. Connections – Counter Electrodes

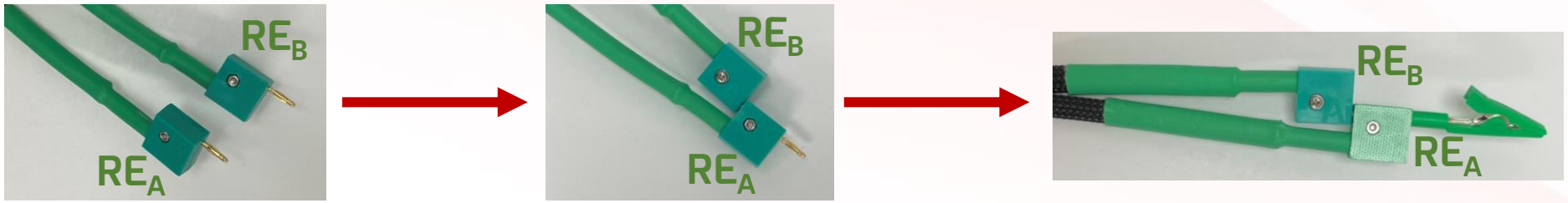
- Insert the counter sense electrode (**CSE_B**) of **Potentiostat B** into the back of **CE_A**
- Attach the four electrodes via **CSE_A** to the counter electrode



3. Connections – Reference Electrodes

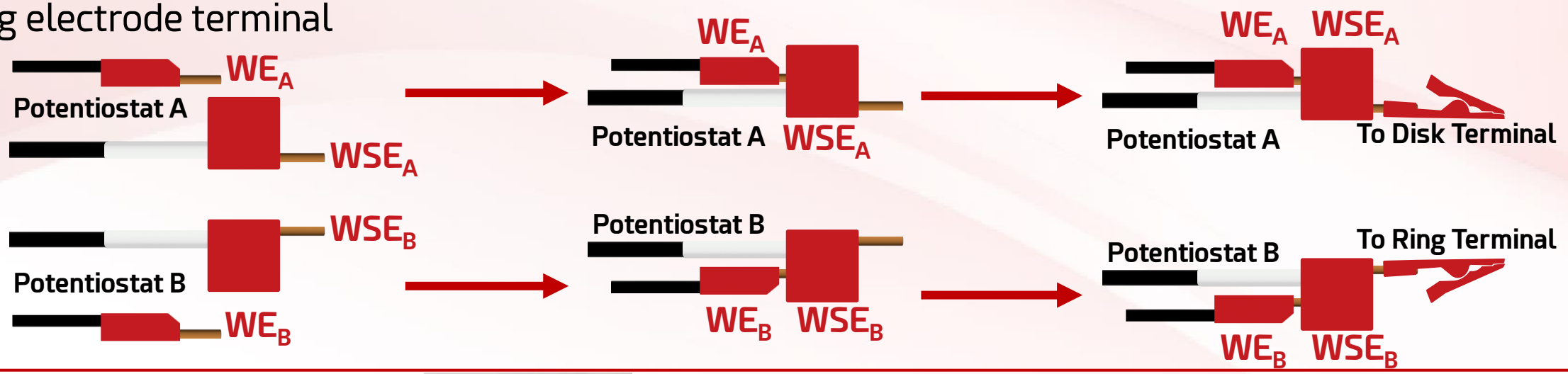
- Insert the reference electrode (RE_B) of **Potentiostat B** into the back of the reference electrode (RE_A) of **Potentiostat A**
- The reference electrode (RE_A) of **Potentiostat A** should terminate with a clip to attach to the shared reference electrode

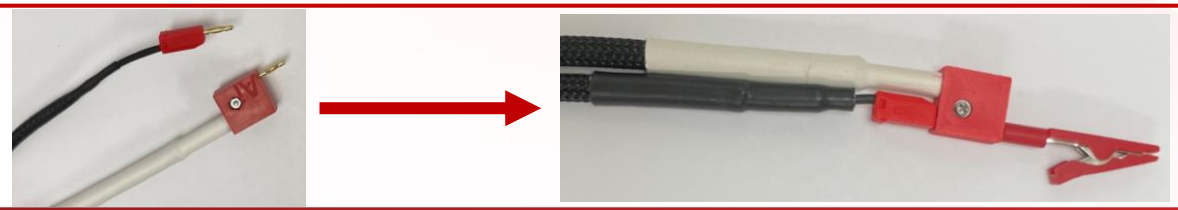




4. Connections – Working Electrodes Standard Configuration

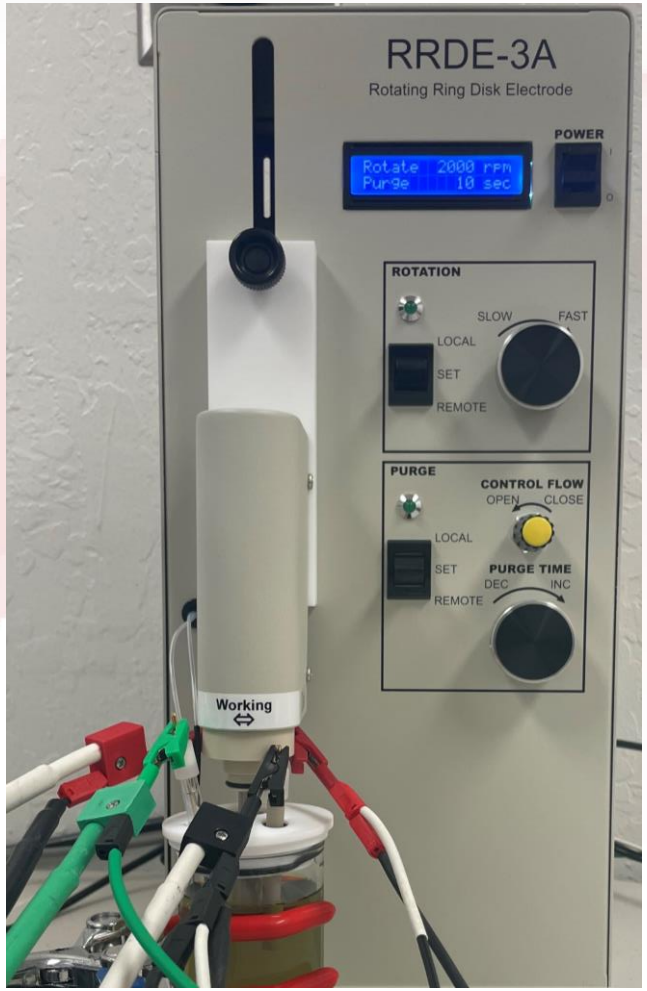
- Insert the working electrode (WE_A) of **Potentiostat A** into the back of WSE_A
- Insert the working electrode (WE_B) of **Potentiostat B** into the back of WSE_B
- The working sense electrode (WSE_A) of **Potentiostat A** should terminate with a clip to attach to the disk electrode terminal
- The working sense electrode (WSE_B) of **Potentiostat B** should terminate with a clip to attach to the ring electrode terminal





5. Final Standard Configuration

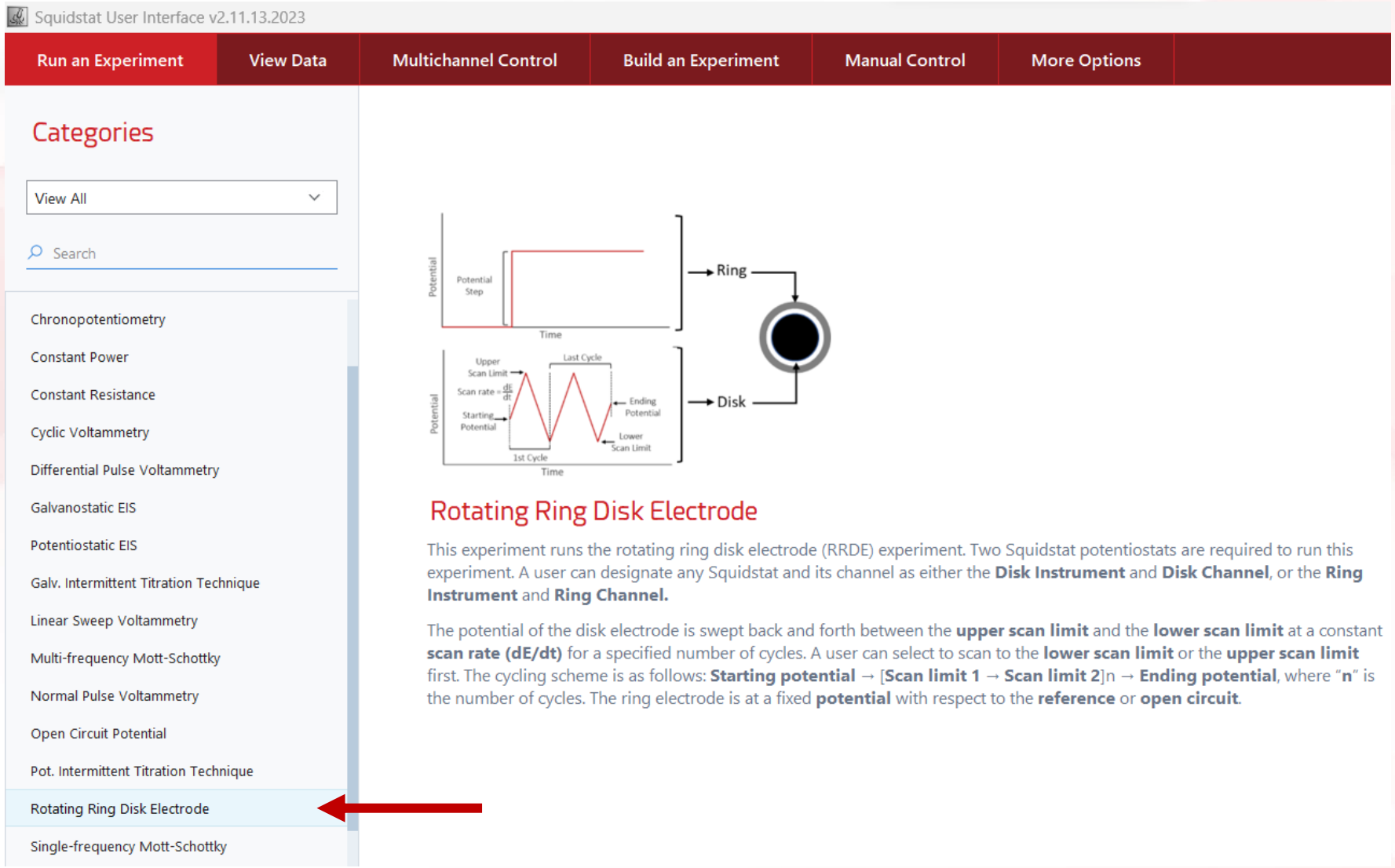
Complete Assembly



Disk Connection

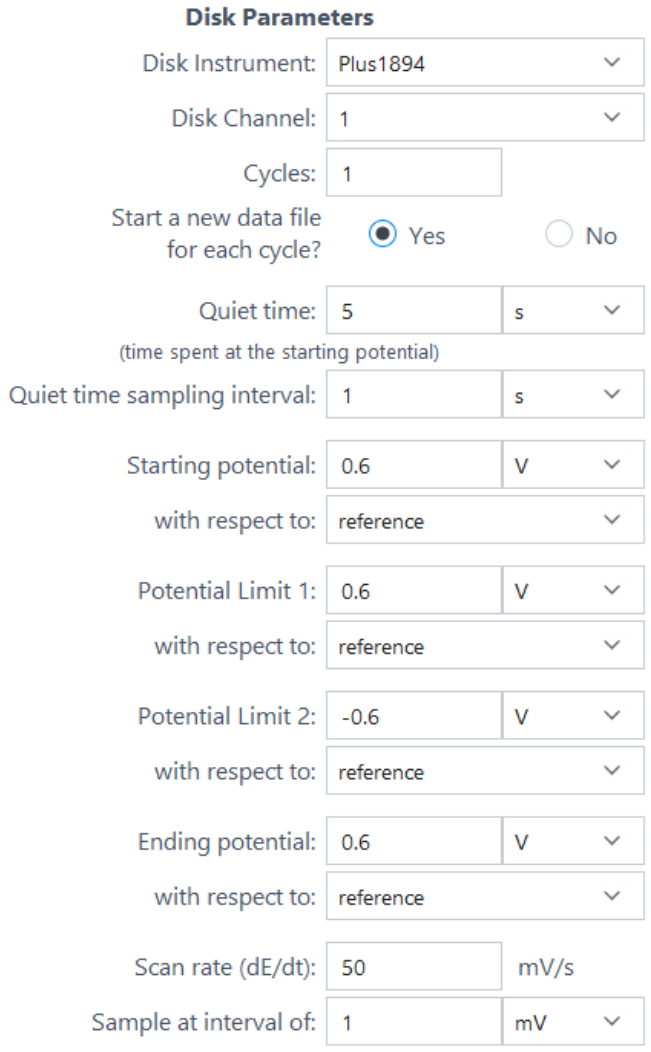
Ring Connection

6. Preconfigured RRDE Experiment in SUI



7. Select **Potentiostat A** for the Disk

Parameters



Select **Potentiostat A** to be used at the Disk

This will produce a new .csv file for every cycle

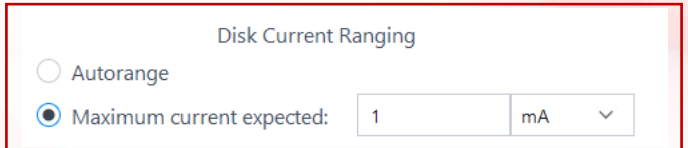
Start of quiet time parameters

Start of cyclic voltammetry parameters

Set potential vs reference or OCP

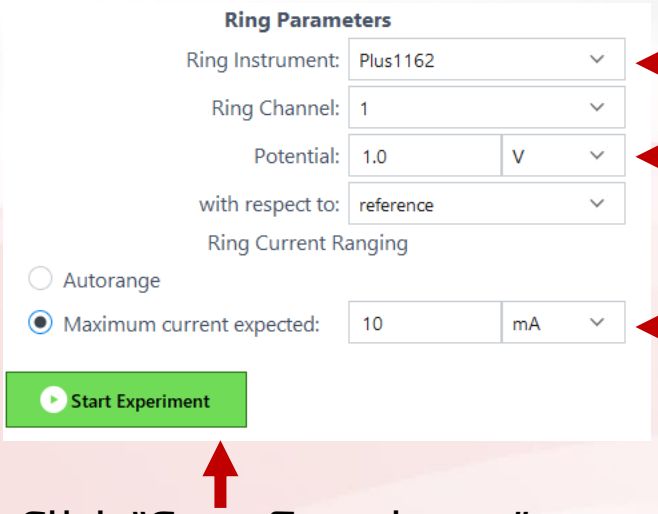
Set scan rate

Set sampling rate



- Ensure "Autorange" **is not** selected
- Set the current range to the maximum value expected for experiment

8. Select **Potentiostat B** for the Ring, Start Experiment



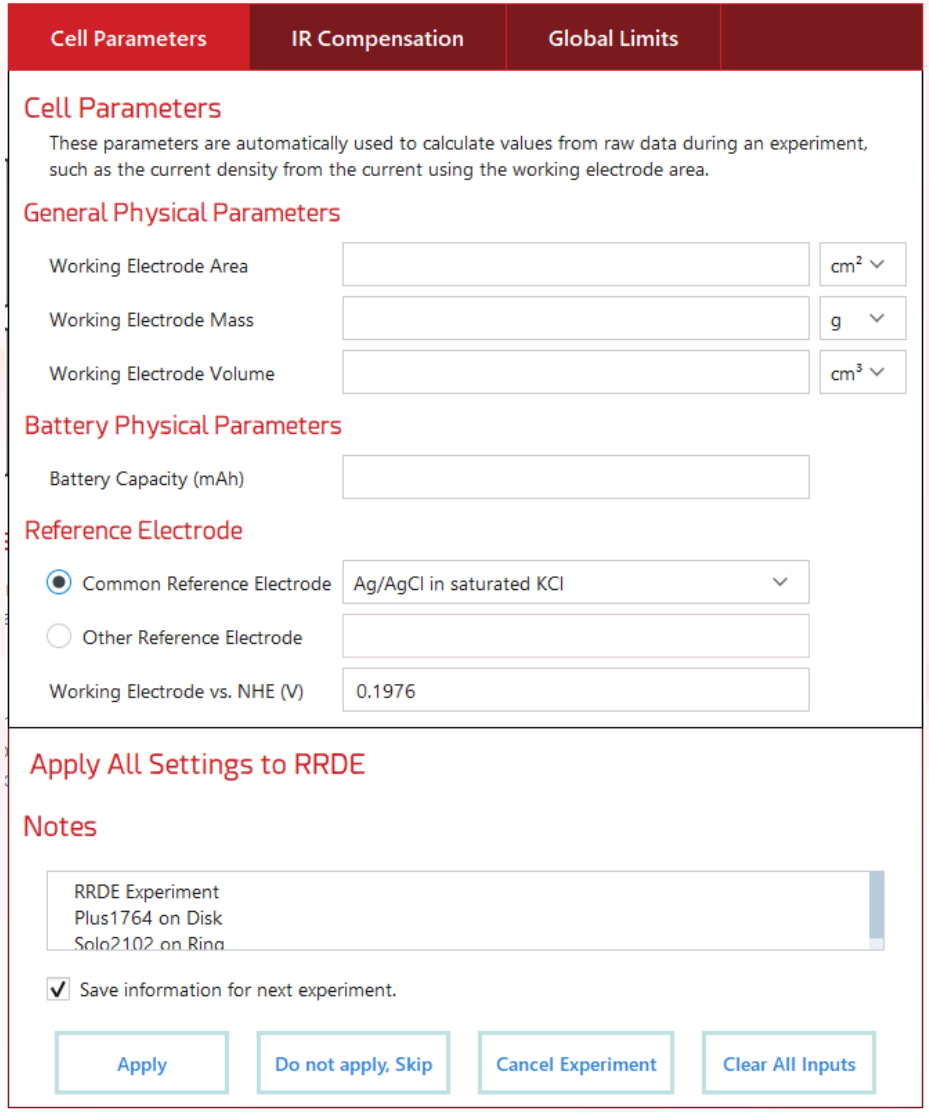
Select **Potentiostat B** to be used at the Ring

Set potential (V) for the ring to be held at

Do not use "Autorange" Set to maximum current for experiment

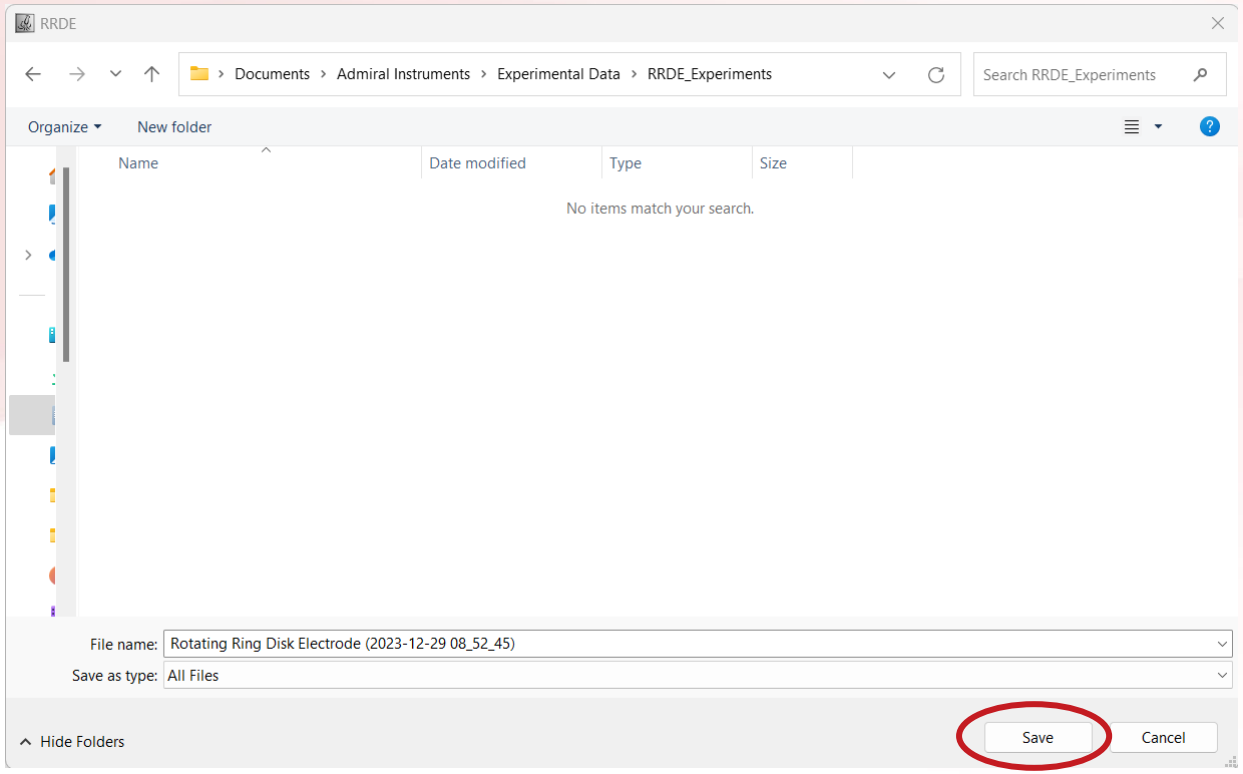
Click "Start Experiment"

- A pop-up window will appear
- Physical electrode parameters can be set
- Reference electrode type can be set
- Experimental notes such as which instrument is connected to which electrode can be easily saved
- Clicking "Apply" will save all information on this window to the experimental log and proceed
- Clicking "Do not apply, Skip" will not save any info on this window and proceed

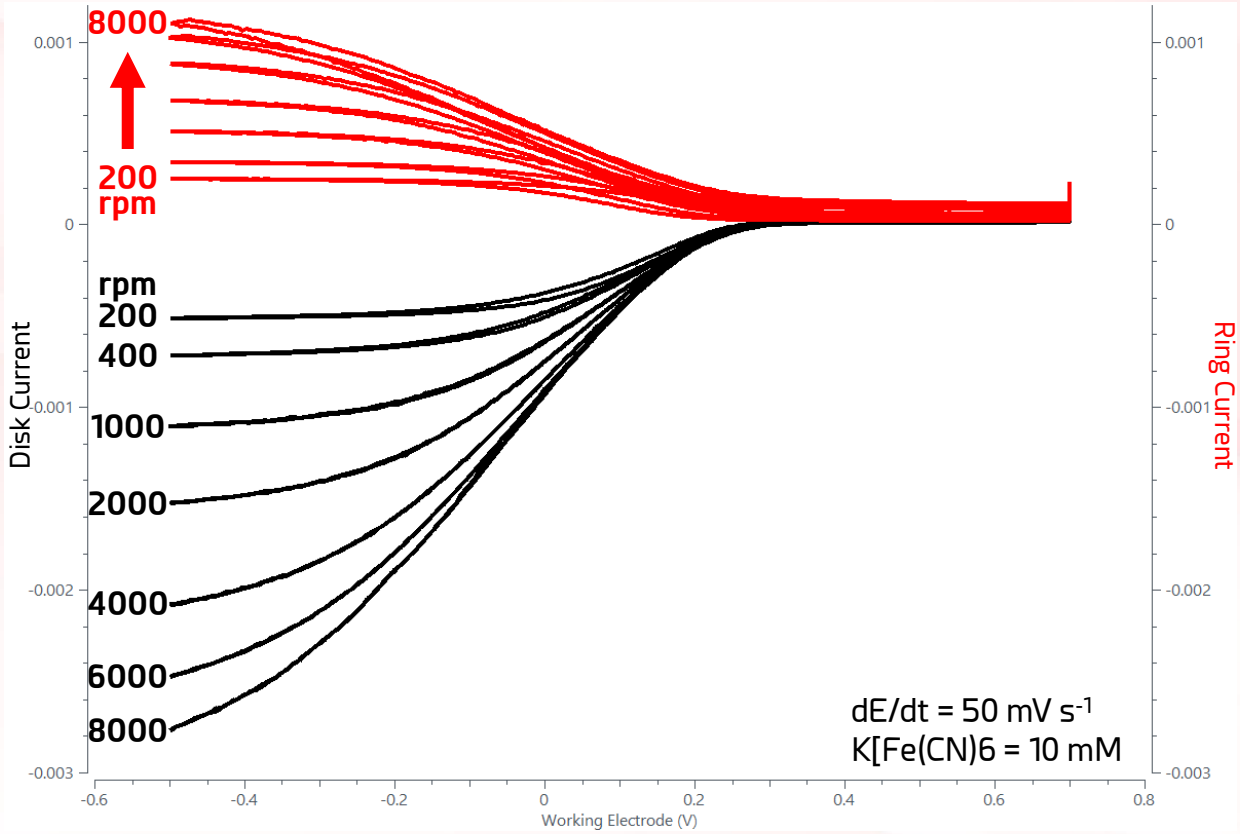


9. Set Save Location and Begin Data Collection

- A final pop-up window will appear.
- Set the file save location for a new experiment folder.
  - Default location is within the Admiral Instruments folder under Experimental Data
- New folder name will include experiment type and time stamp to avoid overwriting previously collected data



- Upon starting data collection, the SUI will switch to the "View Data" tab
- Experimental data can be viewed in real time for both the ring and the disk.



Performance Note

- Bipotentiostat mode was tested up to a current response at the disk of 5 mA (40 mA cm^{-2}).
- Collection efficiencies matched or exceeded calculated theoretical values for the RRDE electrode in use from 100 to 6000 rpm.
- If unexpected behavior is observed above our benchmark values, please contact admiral instruments at contact@admiralinstruments.com

Summary

- This application note provided a step-by-step guide to operating two Squidstat potentiostats in a bipotentiostat configuration for RRDE applications.
- Preconfigured RRDE experiments were employed via the Squidstat User Interface (SUI)

Additional Resources for RRDE

- **RRDE Technical Application Note** – Admiral Instruments detailed overview of the fundamentals of RRDE experiments.

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