Electrodepostion of Palladium as an Ohmic Contact for Single-Walled Carbon Nanotubes

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Carbon Nanotubes: Definition and Application

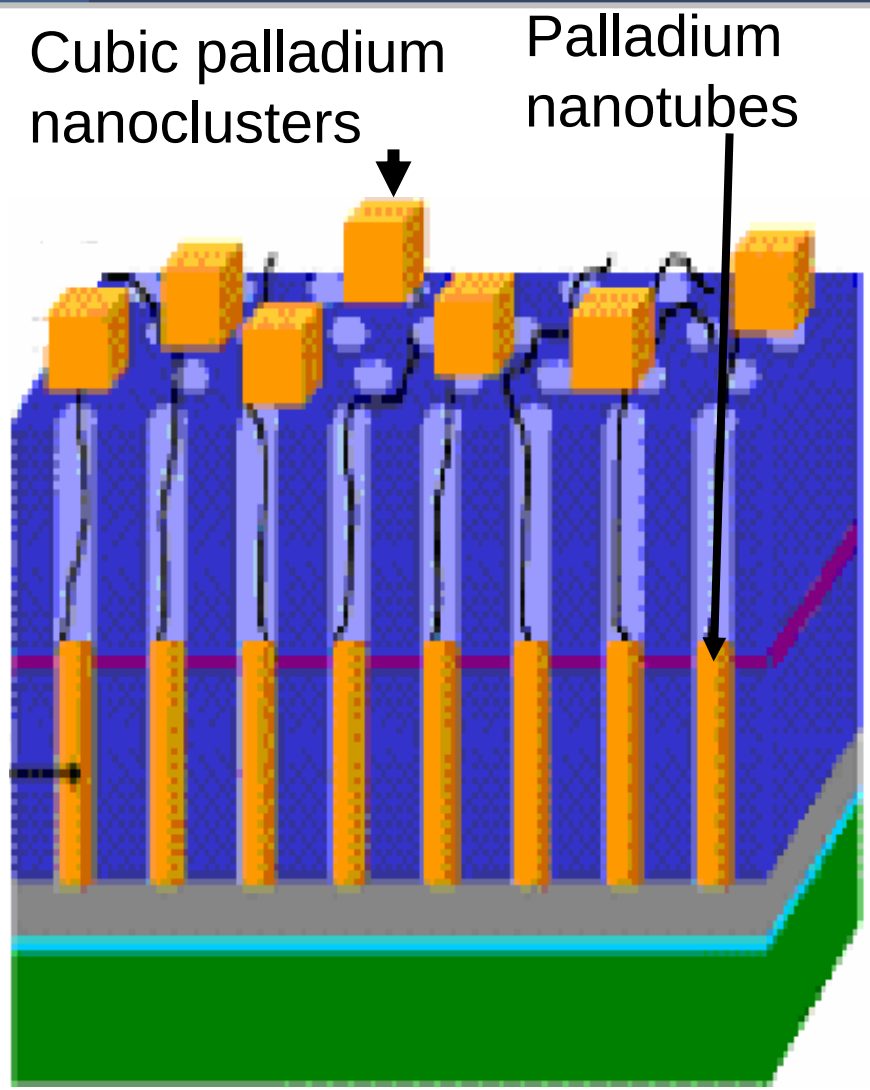
- **Definition of carbon nanotubes**
  - Different kinds of carbon nanotubes:
    - Single and multi-walled
    - Conductors and semiconductors
- **Properties of carbon nanotubes**
  - Mechanical and electrical properties
- **Applications for carbon nanotubes**
  - Current and potential future uses

Research Motivation

- **Methods for growing carbon nanotubes**
  - Arc discharge
  - Laser ablation
  - Chemical vapor deposition
- **Problems with current methods:**
  - Controlling growth
  - Removing impurities
  - Obtaining commercial amounts

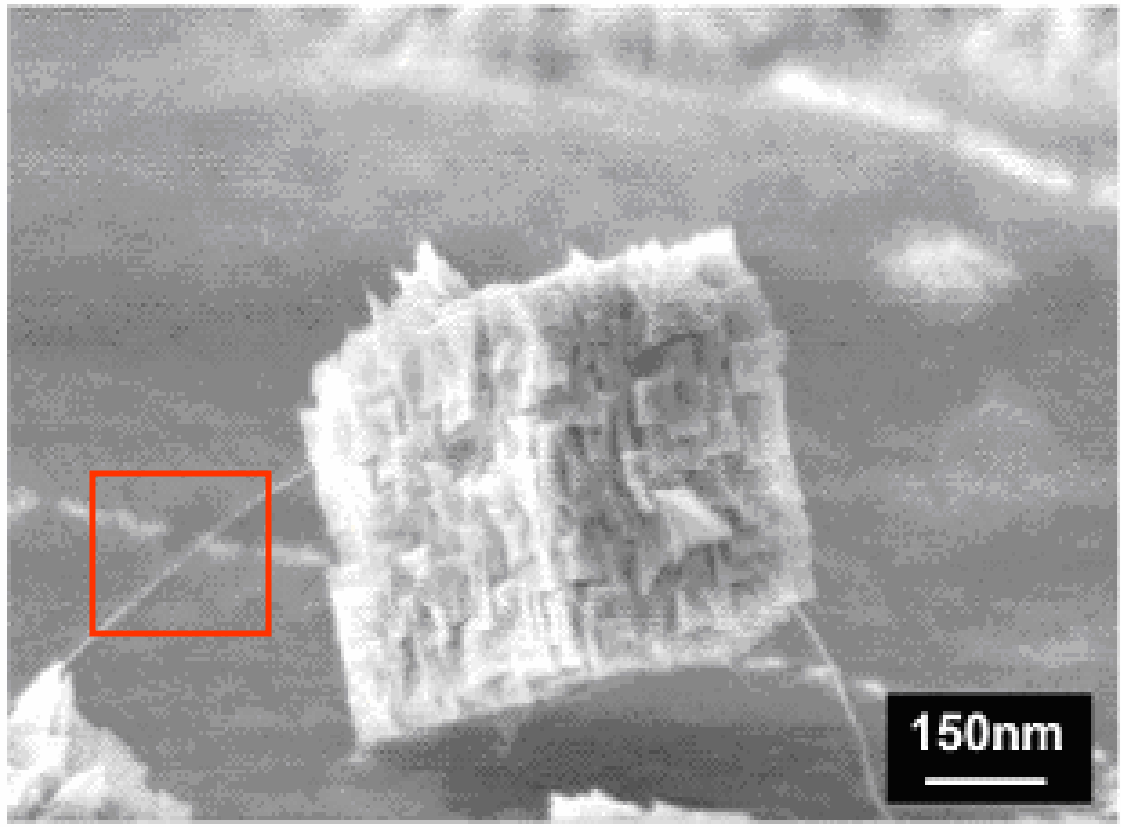
Creating and Contacting SWNTs

- **Porous anodic alumina template embedded with iron**
- **Plasma-enhanced chemical vapor deposition**
- **Electrodeposition of palladium for contacts**



Palladium Nanoclusters as Top Contacts

- Continued deposition forms palladium nanoclusters
- Overall purpose:
  - Controlled deposition of palladium nanoclusters



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Electrochemical Processes

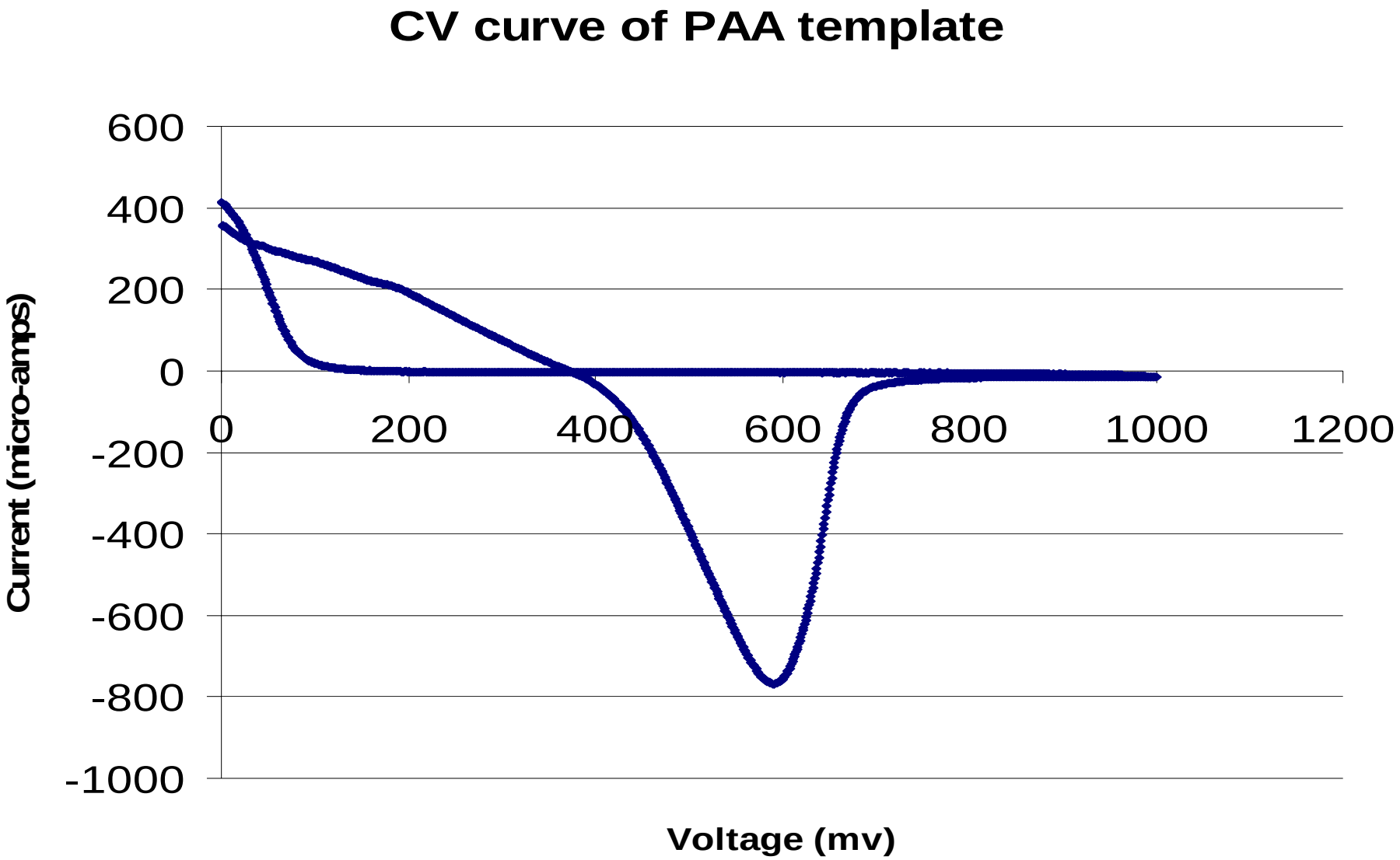
- **Purpose of the electrodeposition**
  - Necessity of contacts for carbon nanotubes
- **Cyclic voltammetry**
  - Overview of cyclic voltammetry (CV)
  - Description of how it works
  - Graphs it generates
  - Applications of CV graphs
    - Detection of when reaction occurs
    - Determination of formal reduction potentials

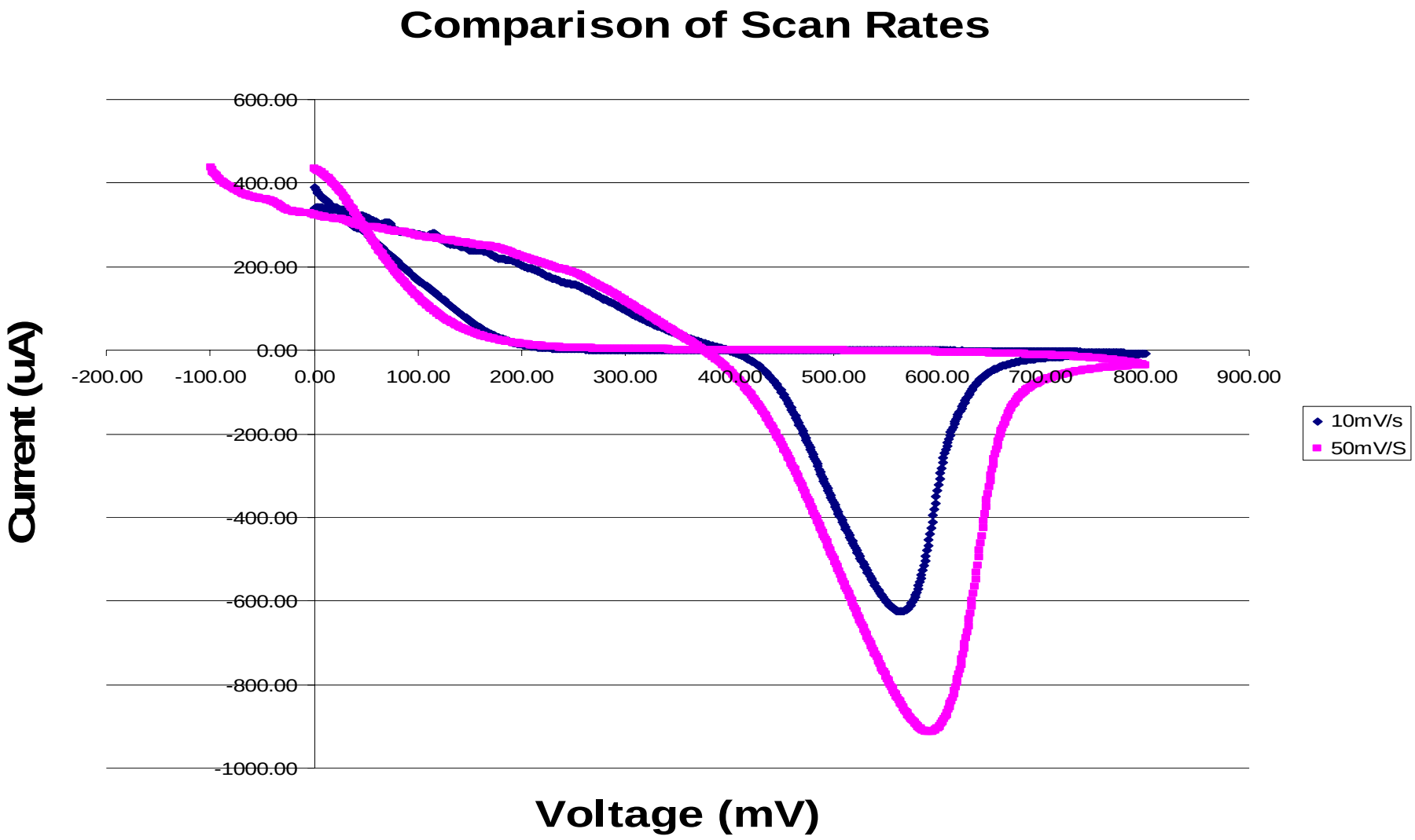
SURI CV Research

- **Creating multiple CVs**
  - Changing where the CV is performed
  - Comparing differences between CVs
  - Determining how effective electrodeposition is

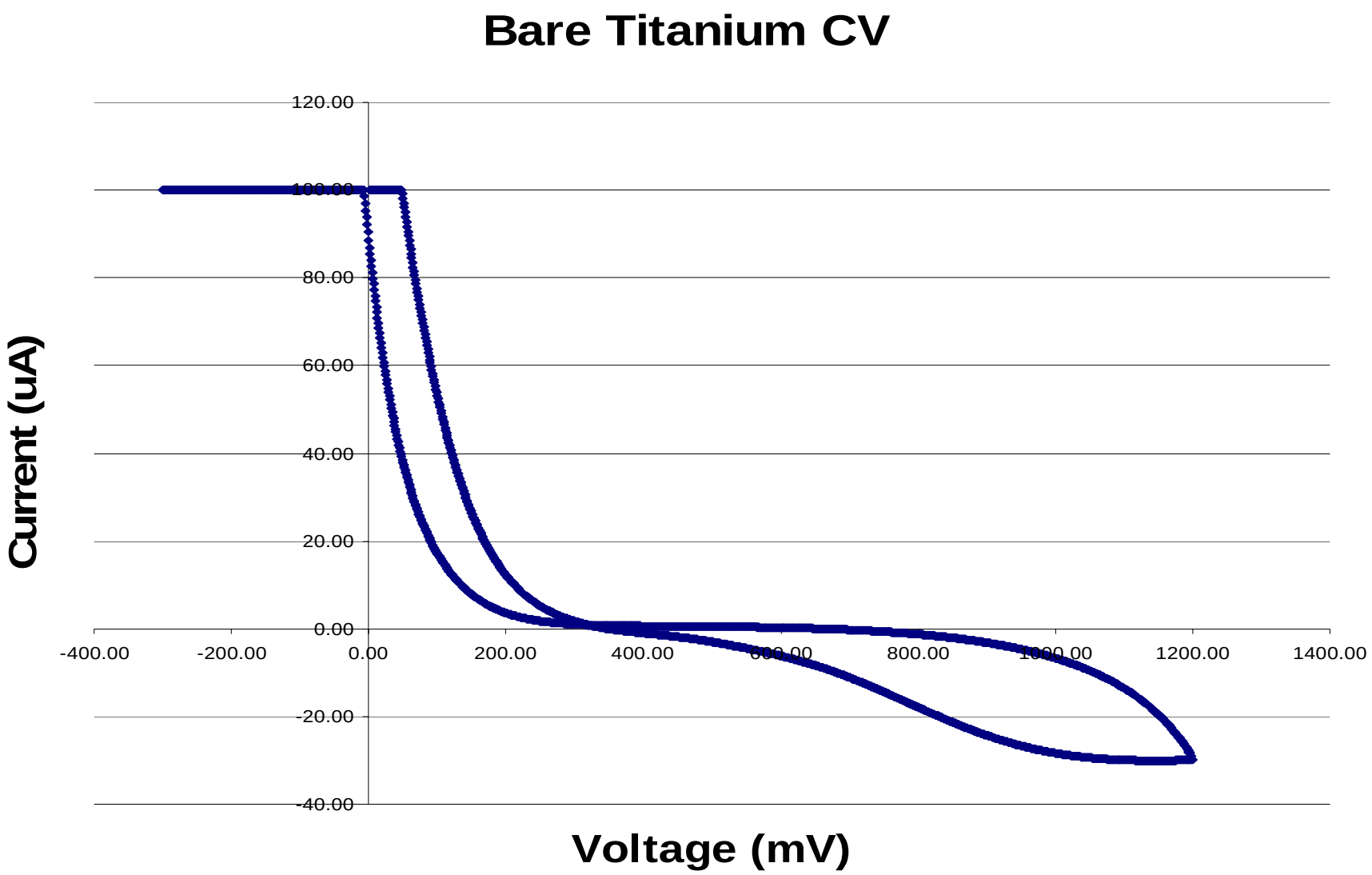
- **Demonstrating characteristics of typical CV**
  - Peak current
  - Peak potential separation
  - Kinetic region
  - Scan rates

PAA template CV




Comparison of Scan Rates
600.00
400.00
200.00
0.00
-200.00
-400.00
-600.00
-800.00
-1000.00
-200.00
-100.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
Current (uA)
Voltage (mV)
10mV/s
50mV/S

Titanium Layer CV



Interpretation of the CV Curves

- Porous anodic alumina template
  - Peak potential separation > 58 mV
  - Decreased rate constant of reaction
    - Longer time for current to respond in comparison
- Titanium layer
  - Peak potential separation much > 58mV
    - Demonstrates electrodeposition kinetics versus PAA

- **Problems with experiment:**
  - Reactor down
  - Cooling leak
  - Equipment transfer

Future Research

- **CVs from other locations:**
  - CVs from single walled carbon nanotubes
  - CVs from top surface of the carbon nanotubes
    - Deposition can be potentially controlled
- **Comparisons with previous CVs**
  - Information about deposition process

Acknowledgments

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