

Nanostructured Photovoltaic Cells Fabricated with PAO (Porous Aluminum Oxide) Templates

Lin Li

(Mechanical Engineering)

Santa Barbara City College

Lab Mentor: Martin Schierhorn

Faculty Advisors: Galen D. Stucky

Martin Moskovits

Department of Chemistry & Biochemistry, UCSB

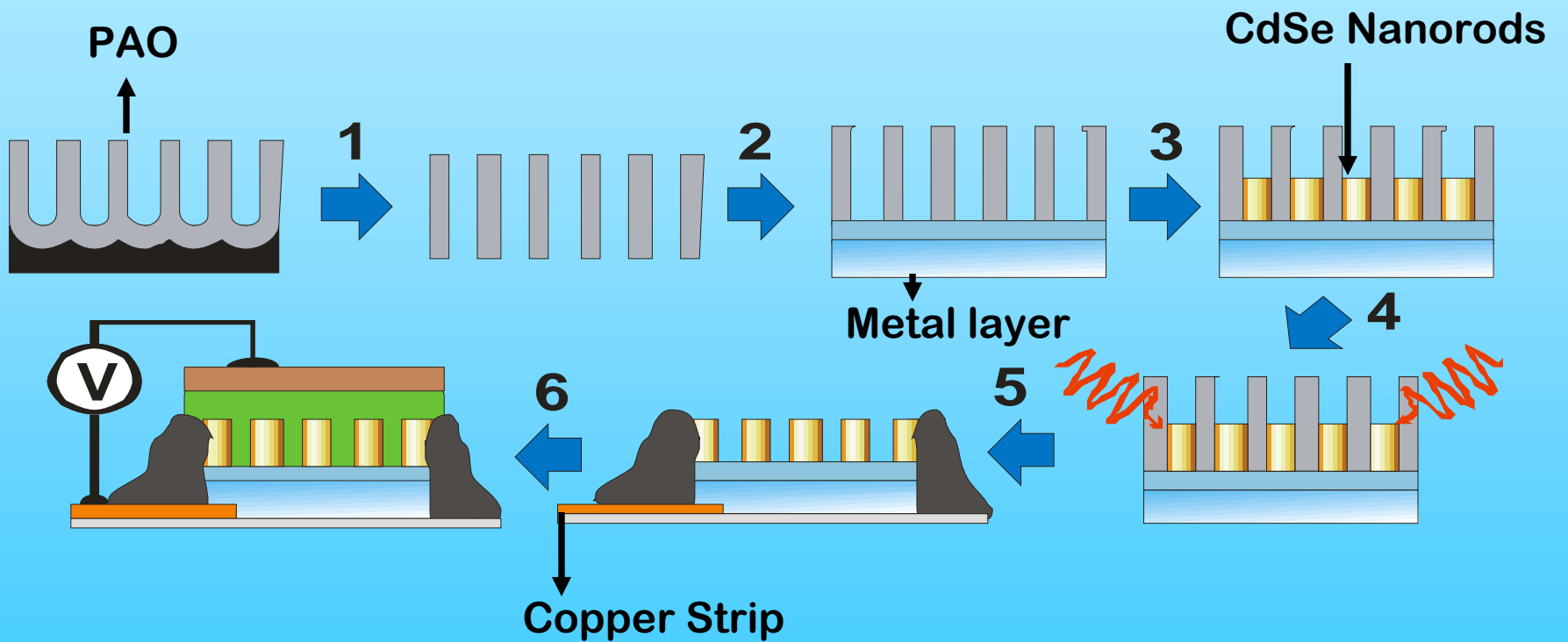
**Funding: The Institute for Collaborative
Biotechnologies (ICB)**

★ Application of Nanostructured Photovoltaic Cells Fabricated with PAO Templates

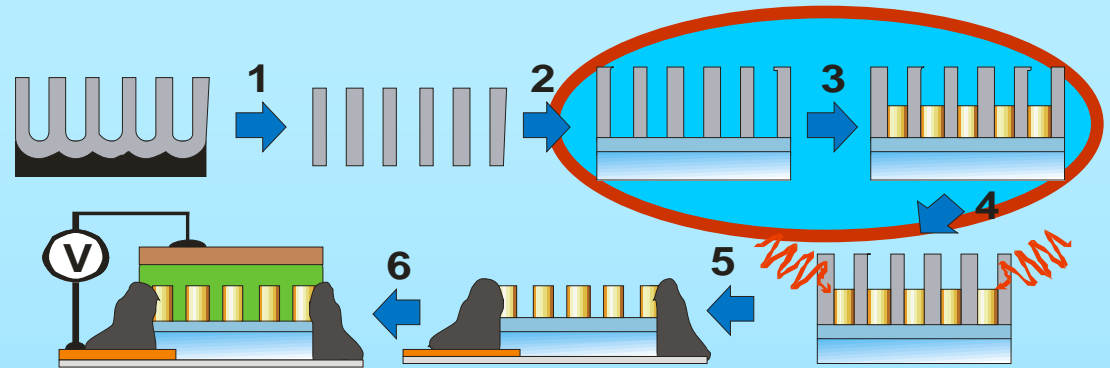
1. Energy Source:
solar power
(free and renewable)
2. Development of Materials:
flexible, cost-effective, easily processable
(such as polymers)



★ Procedure of Making CdSe Cells



Goals



Find optimal thickness of TiO₂

decreased recombination kinetics

Try out different metal layers instead of gold (Ti or Ni)

limit the Schottky barrier issues

Play around with different dimensions of nanorodes

Increase the absorption of photons

★ Preparation of PAO Templates

- **First Anodization**

1. **Condition:**

- 0.3 M oxalic acid
- 15 degree C
- 40 Volts for 3 hours

2. **Removed with H_3PO_4 / H_2CrO_4 at 65 degree C for 2 hours (in the oven)**

- **Second Anodization**

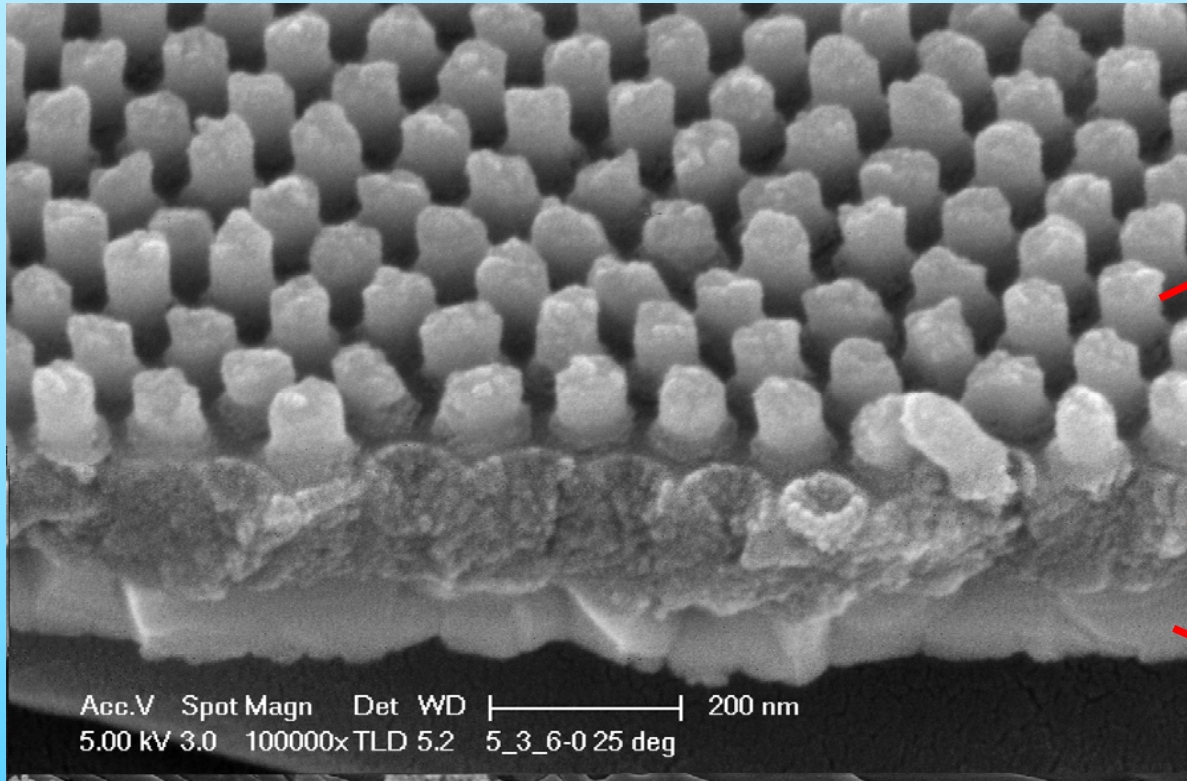
1. **Same conditions for 12 hours**
 - results: pores of ~80 micrometers long by ~40 nm in diameter



Template after 2nd Anodization



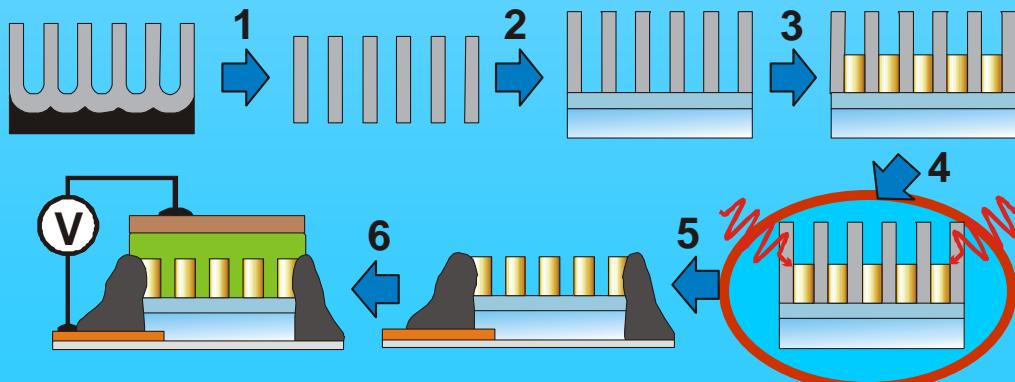
CdSe Nanorods under the SEM



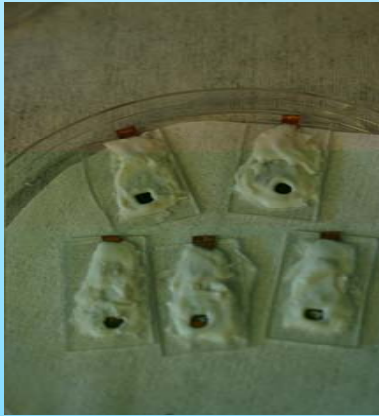
CdSe nanorods

TiO₂ layer

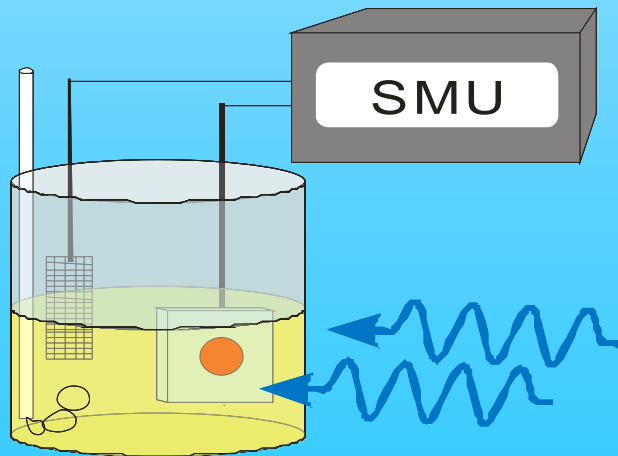
Metal layer (ITO layer)



★ Electrochemical Photovoltaic Characteristics of CdSe



CdSe samples

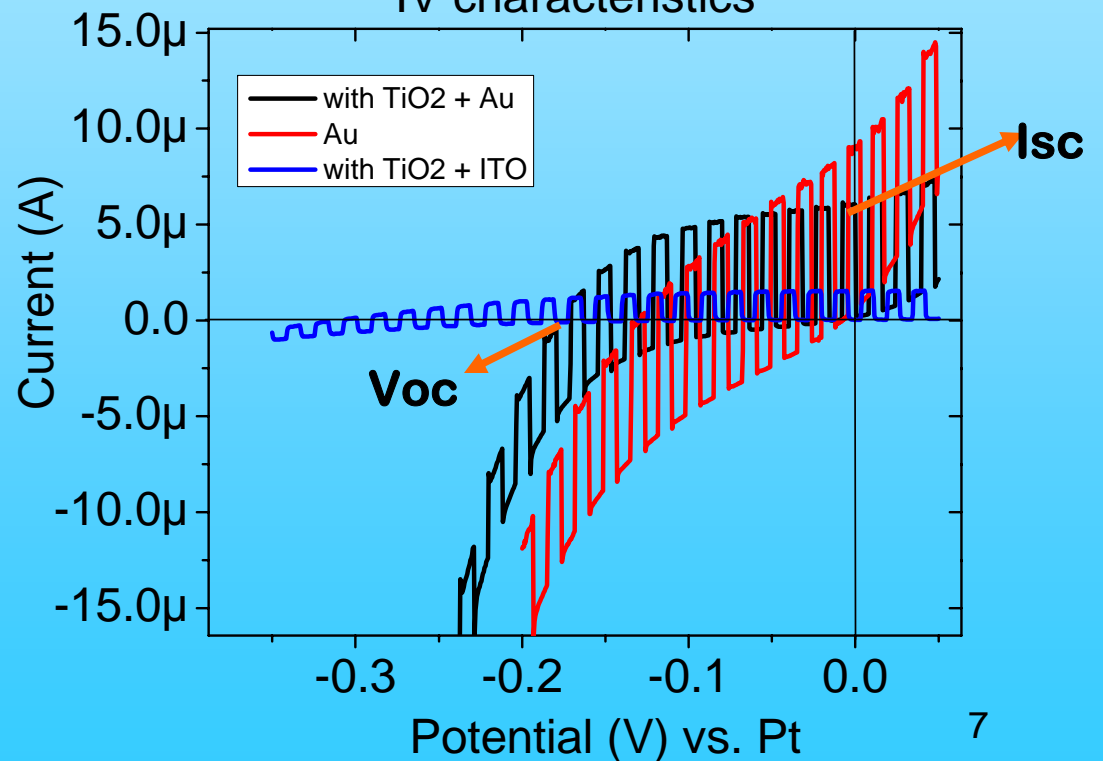


Equipment for testing

$$\text{Efficiency} = \frac{(V_{oc} * I_{sc} * FF)}{(100\text{mW}/\text{cm}^2)}$$

- V_{oc} – open circuit voltage
- I_{sc} – short circuit current
- FF – fill factor

IV characteristics



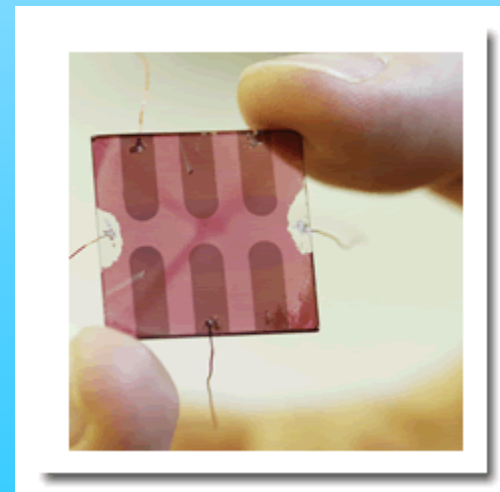
★ Summary

• Conclusions

1. IV Curve shows that TiO_2 layer leads to better efficiency than the one without it
2. TiO_2 layer decreases recombination kinetics

• Future Plans

1. Combine P3HT polymer with CdSe half solar cells
2. Substitute with new polymers



P3HT
polymer

• Picture comes from:
www.bee.qut.edu.au/.../projects/photovoltaics

★ Acknowledgements

- Mentor: Martin Schierhorn →
- Adviser: Galen D. Stucky
Martin Moskovits
- Professors: Nick Arnold
& Dr. Young

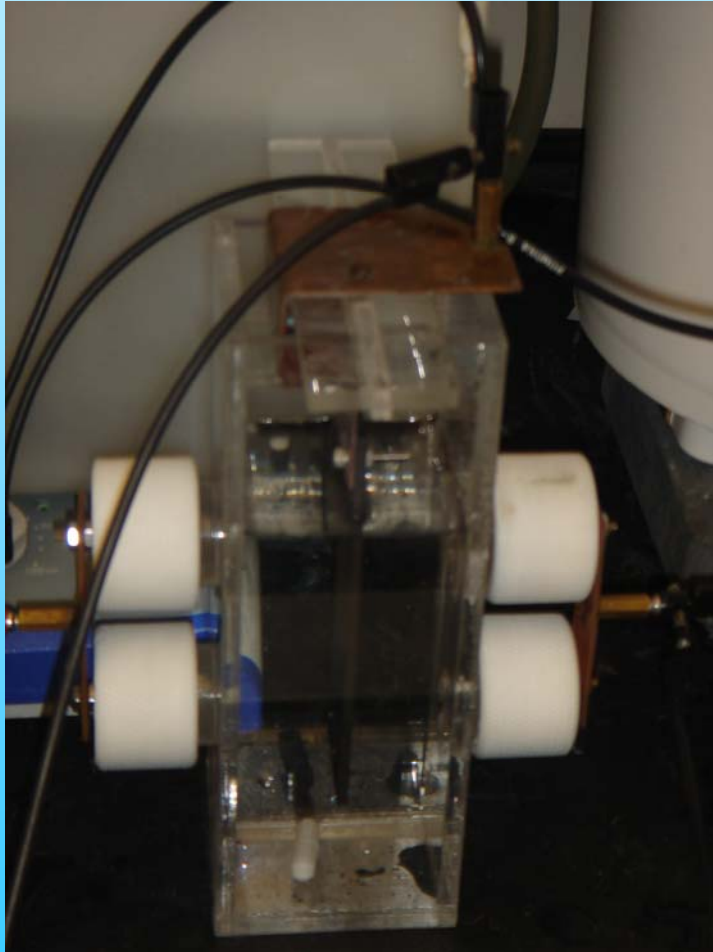


- Funding Source: The Institute for Collaborative Biotechnologies (ICB)
- Summer research program: INSET

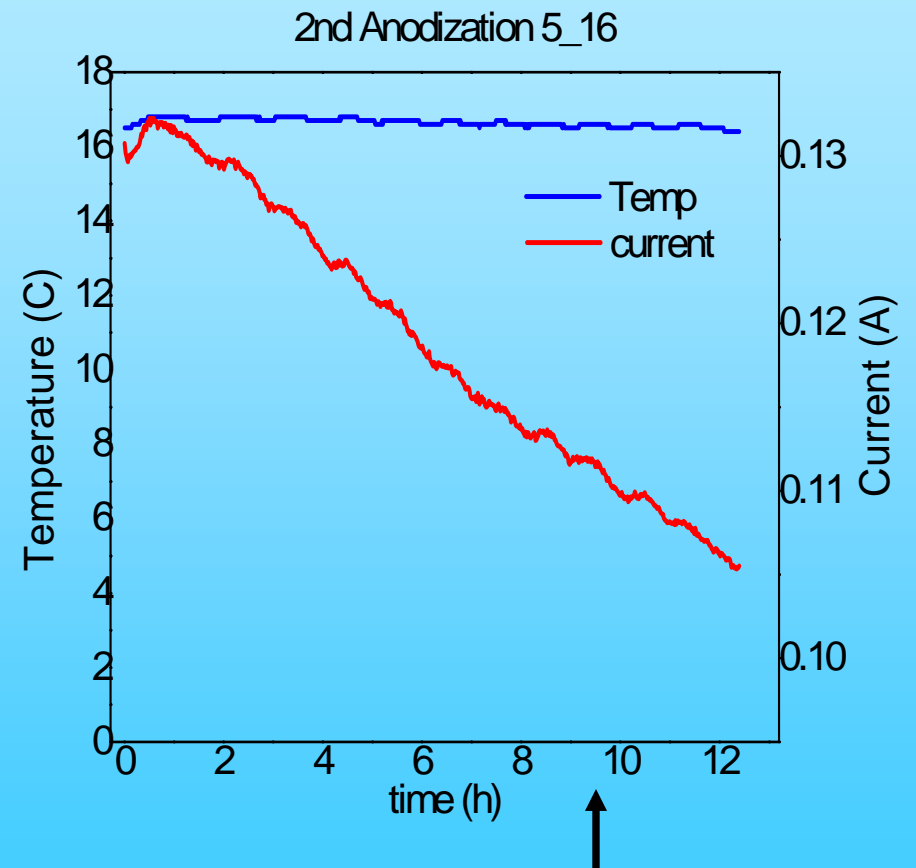


★ THANK YOU !

★ Diagrams of Anodization



Equipment for Anodization



Time vs. Temperature & Time vs. Current

PAO Templates

- PAO Templates



(With gold layer)

(With ITO layer)