



# Materials Chemistry for Energy

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1. Nano-Structured Materials for Solar Photoelectrolysis for H<sub>2</sub> Production



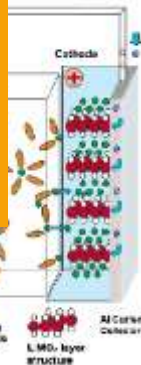
Prof. Heller



Prof. Stevenson



S



Ga As collector, Photocatalytic structure, Solvent Molecule, LMO layer structure, Al Contact Cathode

2.



Gold Clusters

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3. Anode

Li-Ion

Large-Scale Use

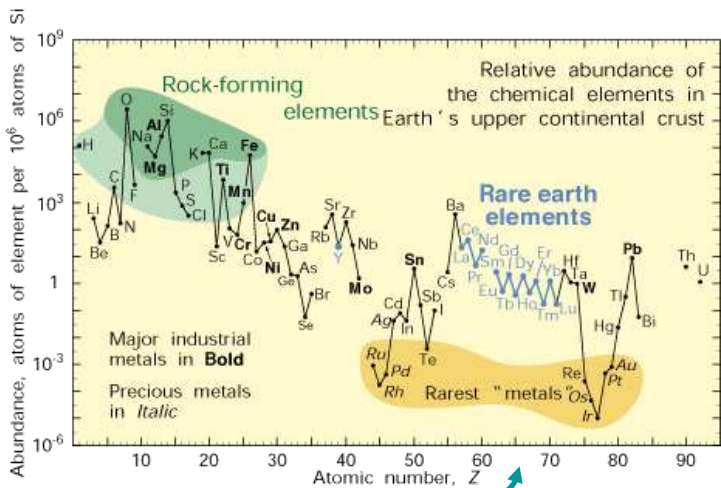


Prof. Heller

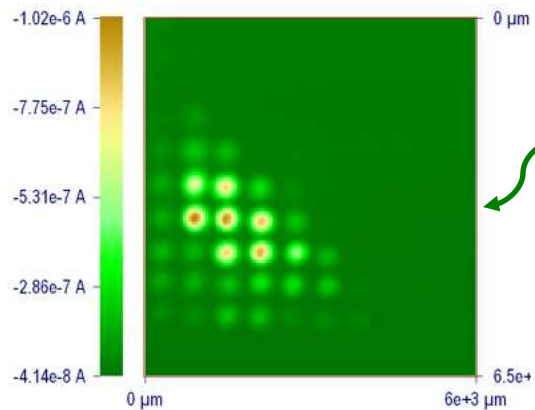
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# Solar Photoelectrochemical Water-Splitting with "Abundant" Materials

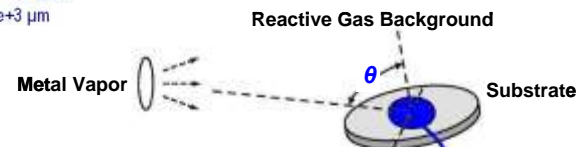


1. Pick "Candidate" Abundant, Metal-Oxide Photoelectrocatalysts

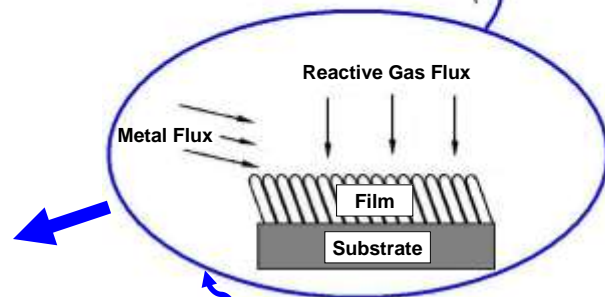


2. Rapid Synthesis And Screening

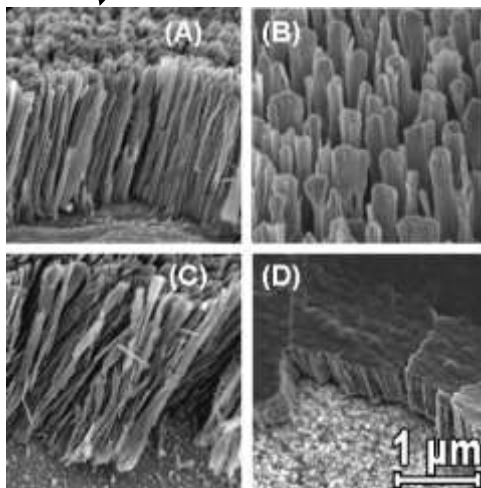
4. Characterize Material



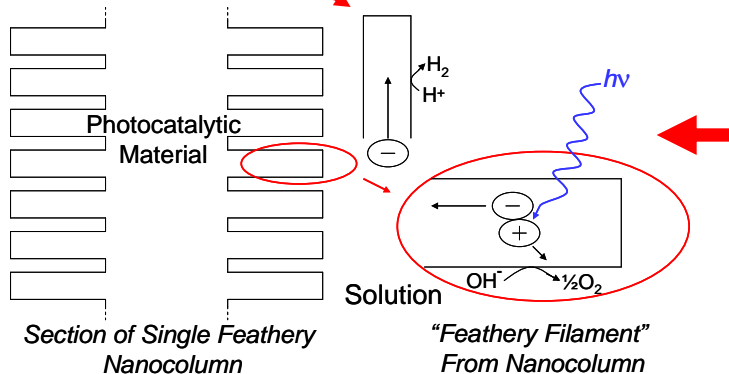
5. Test Photoelectrochemically



3. Deposit Promising Metal-Oxide Materials with Nano-Structured Morphology



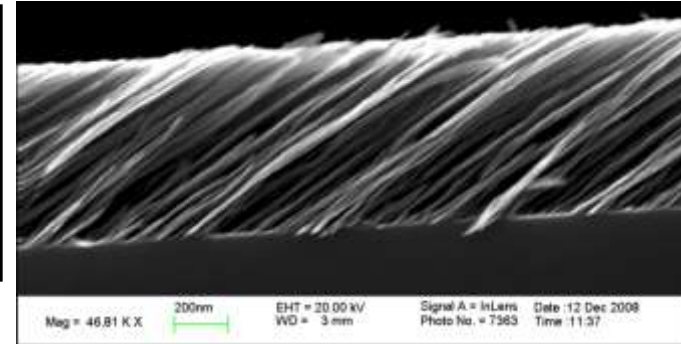
TiO<sub>2</sub> Nano-Structured Films





# Surface Chemistry of Nano-Structured Surfaces

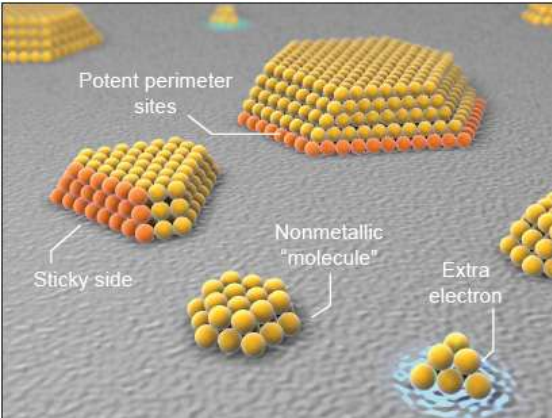
Exploratory studies of catalysis/"surface chemistry" - green processing, fuel cells and fundamental insights.



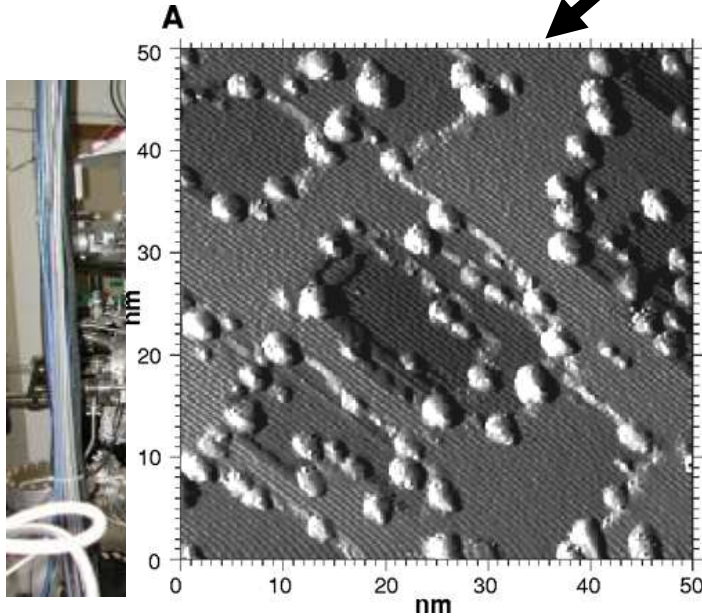
*Nano-Structured Titanium Carbide Film which has Pt-like Catalytic Properties.*

Examples

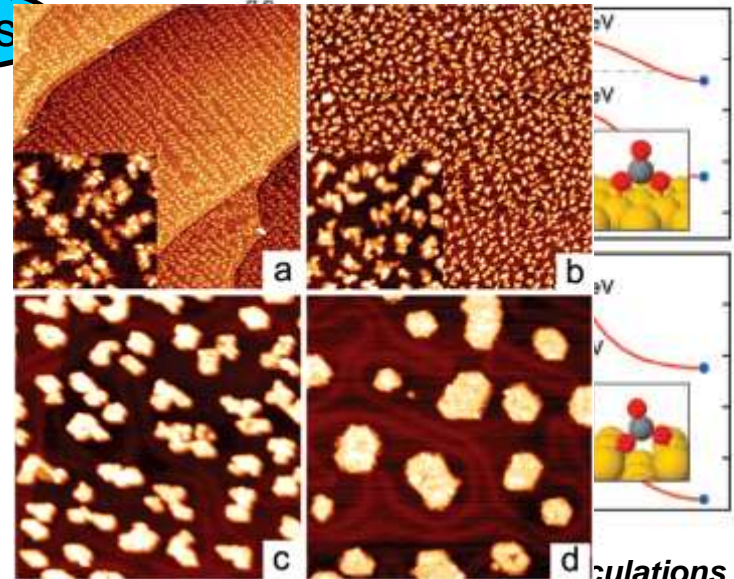
Tools



*Clusters on Supporting Surface*



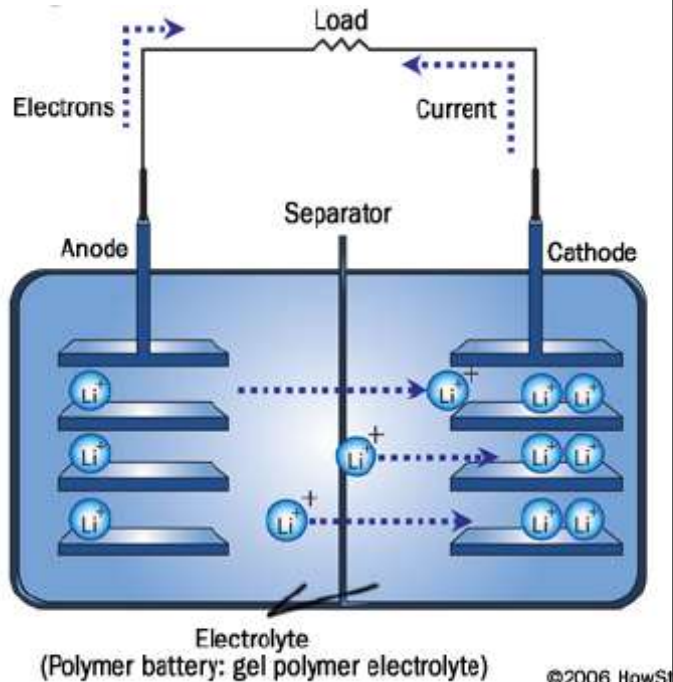
*Experimental Gold Clusters on Titanium Goodman-Science (1998)*



*TiO<sub>2</sub> Clusters on Au(111) Surface and Hwang Osgood, Hrbek-Nano Lett. (2005)*



# Anode Materials for Li-Ion Batteries



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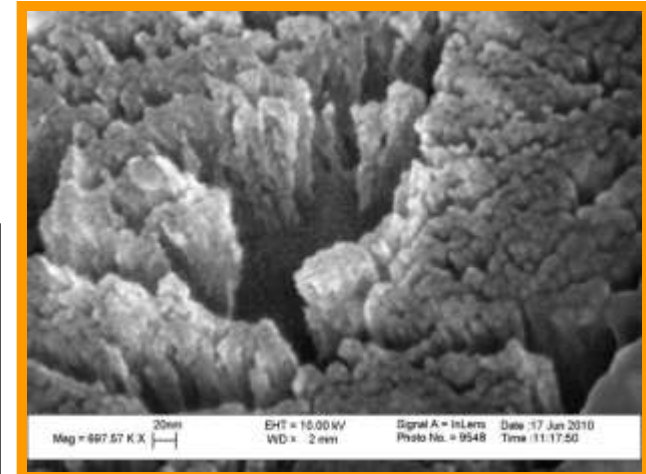
Carbon is typically used as anode in Li-Ion batt.'s but safety issues persist

*Need alternate materials:*

- Low voltage
- High capacity
- High Li transport
- Good electron conductor
- Small volume change
- Low cost and abundant
- Non-toxic and environmentally benign
- etc.



**Iron Oxide Nanorods**



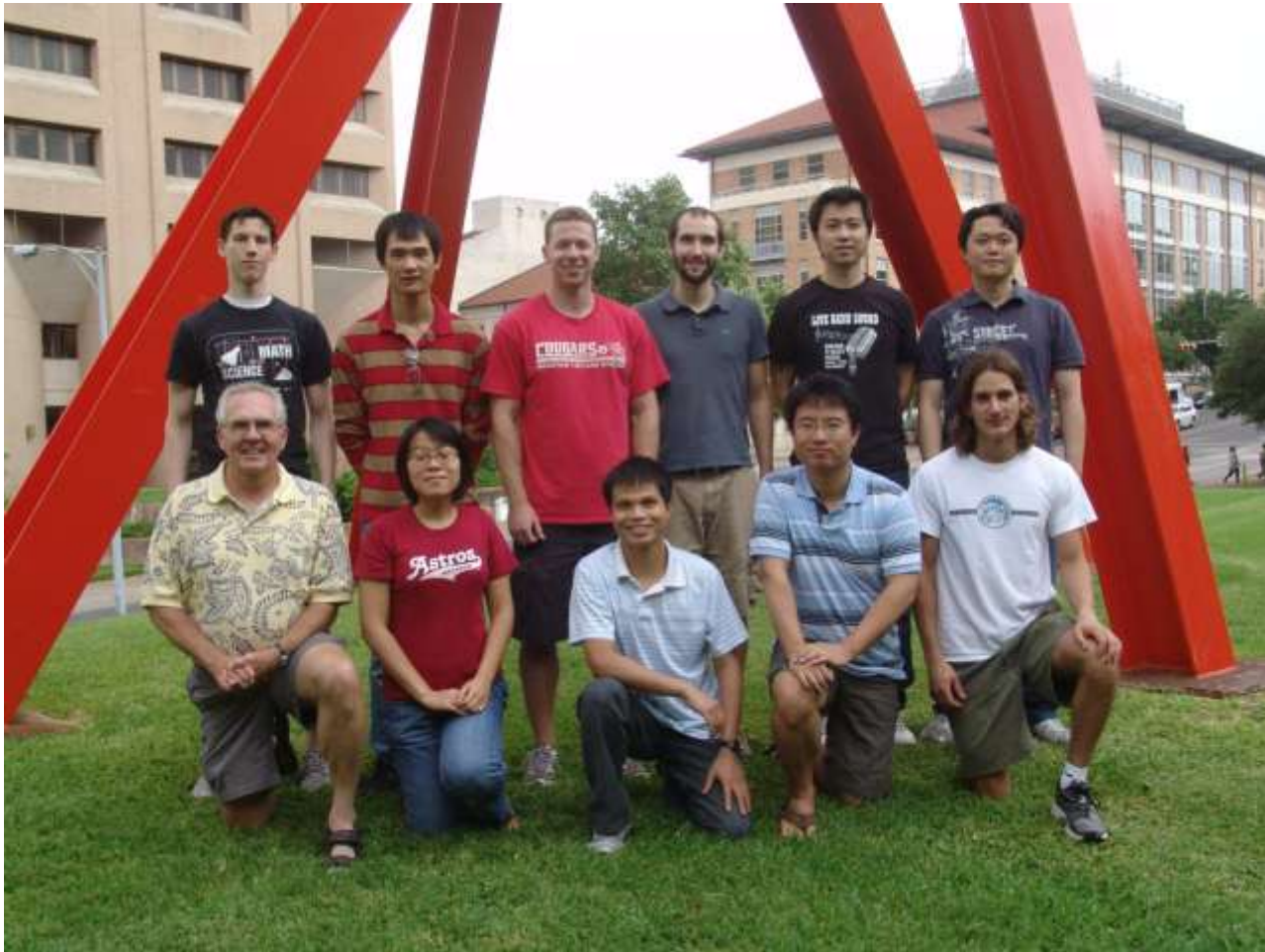
**Copper Doped Silicon Nanorods**



***Our approach involves nanostructured sample synthesis, materials characterization, and electrochem. testing (e.g., Li transport, cyclability, capacity, etc.)***



# Welcome to Austin!!



*Mullins Research Group*