Materials Chemistry for Energy
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2. Surface Chemistry of Nano-Structured Surfaces (Catalysis)

3. Anode Materials for Li-Ion Batteries for Large-Scale Use

Prof. Prof. Prof. Prof. Prof.
Solar Photoelectrochemical Water-Splitting with “Abundant” Materials

1. Pick “Candidate”
   Abundant, Metal-Oxide Photocatalysts

2. Rapid Synthesis
   And Screening

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

4. Characterize Material

5. Test Photocatalytically

Solution

"Feathery Filament"
From Nanocolumn

Section of Single Feathery Nanocolumn

Reactive Gas Flux
Metal Vapor
Reactive Gas Background
Substrate

TiO₂ Nano-Structured Films
Surface Chemistry of Nano-Structured Surfaces

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

Examples

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

Tools

Experimental Surface Science Investigations

Gold Clusters on TiO$_2$ Cluster on Au(111) Surface

Density Functional Calculations with Dr.'s Henkelman and Hwang


Clusters on Supporting Surface

Potent perimeter sites

Nonmetallic “molecule”

Extra electron

Sticky side
Anode Materials for Li-ion Batteries

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.

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

Mullins Research Group