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ADVANCED MATERIAL LABORATORY

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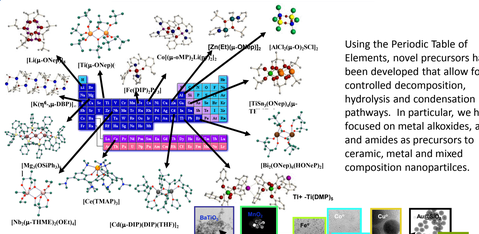
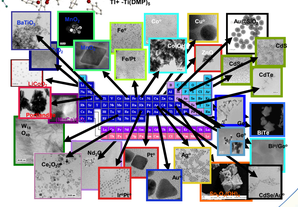
Department 1815 is located at the Advanced Materials Laboratory (AML) – a Sandia-leased facility on the campus of the University of New Mexico

The Advanced Materials Laboratory, a part of Sandia National Labs since August, 1992

Inorganic chemistry for tailored materials



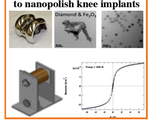
Using the Periodic Table of Elements, novel precursors have been developed that allow for controlled decomposition, hydrolysis and condensation pathways. In particular, we have focused on metal alkoxides, alklyls and amides as precursors to ceramic, metal and mixed composition nanopartilces.



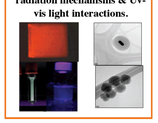
Due to the unique precursors that can be synthesized, novel nanomaterials in size, shape, composition, architecture are available for use. These tailored nanomaterials are not available elsewhere and lead to materials and abilities that are specific to our laboratories

Nanoparticles for Energy, Detection,& Interactions

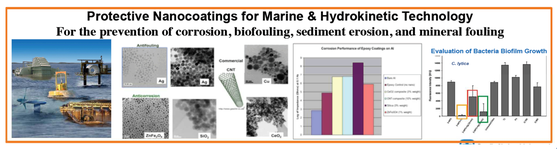
Magnetic Assisted Polishing
Magnetic & Abrasive Particles to nanopolish knee implants



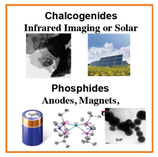
Scintillators & Photonics
Understanding nanoscale radiation mechanisms & Uv-vis light interactions.



Protective Nanocoatings for Marine & Hydrokinetic Technology
For the prevention of corrosion, biofouling, sediment erosion, and mineral fouling



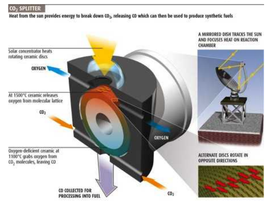
Chalcogenides
Infrared Imaging or Solar



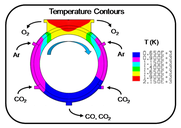
Phosphides
Anodes, Magnets,

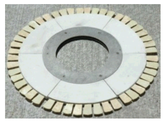
The "Sunshine to Petrol" (S2P) Challenge Integrates a Variety of Sandia Capabilities.

Basic Premise: *Sunlight + CO_2 + H_2O → Fuel + O_2*



Catalytic ceramic fins are the key to the necessary reactions



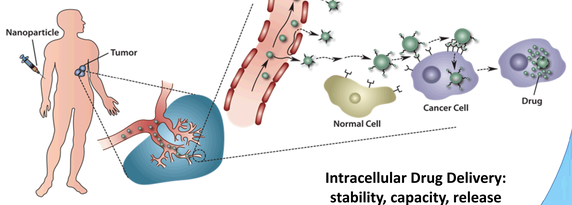


By collaborating with several universities and industry partners, we have assembled the capability to move this concept from the lab-scale to a commercial-scale demonstration.

Engineered Nanoparticles for Targeted Delivery of Diverse

Time in Circulation: size, charge, surface modification(s), shape

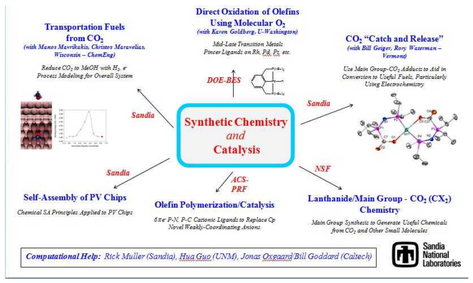
Selective Binding & Internalization: type & density of targeting ligand(s), size, charge, shape



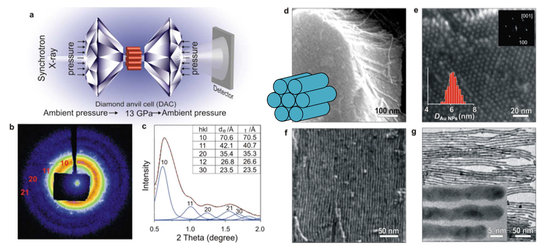
Intracellular Drug Delivery: stability, capacity, release kinetics

Penetration into Tumor(s): size, charge, surface modification(s), shape

Catalysis work builds on our strategic investment in



Develop Multi-funcitonal Nanomaterials and Unravel Sructure-Property Relationship



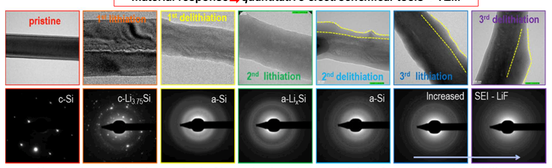
- Self-assembled large area of nanoparticle coatings (R&D 100 Award + FLC Technology Transfer Award)
- Nanoparticle Coatings to Near Infrared Reflectors (2007 R&D 100 Award)

Precision Nanoscale Electrochemistry

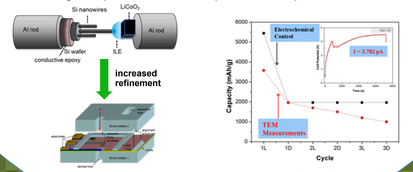
Nanoscale materials promise improvements in battery performance

- capacity and energy density through nanoscale alloy formation (Li –Si)
- power density through decreased charge transport distances

Goal: develop nanoscale diagnostics to explore in operando material response ➡ *quantitative electrochemical tools + TEM*

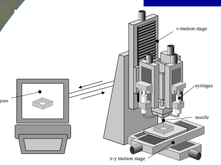


New understanding is required of how size impacts material performance and reliability



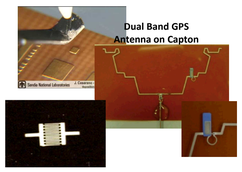
imaging the response of a single Si NW as it is alloyed and de-alloyed with lithium

Direct Write and Roll-to-Roll Precision Printing is Unique in the Complex

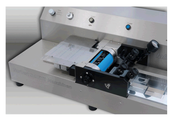


Direct write ceramics: Computer controlled robotic deposition of custom and COTS ceramic slurries and metal "inks" allow fabrication of ceramic parts.

Direct write electronics: Conductive lines and electrical components can be printed on almost any substrate with room temperature "curing."



Gravure printed materials: Nanoinks and polymers printed on any flexible or rigid substrate down to 2 micron resolution and 10 micron overlay registration in a roll-to-roll system.



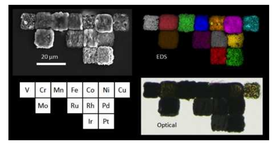
RG Gravure Printing Tool

Laser-based Lithographic Methods for Nanomaterial Synthesis and Patterning

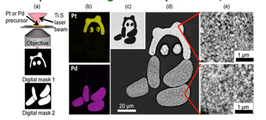
Mask-Directed Multiphoton Lithography (MPL)

Kaehr and JACS 2007 129 (7),1904-1905.
Nielson, Kaehr and Shear, Small, 2005, 1, 120-125Shear,

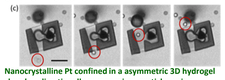
For arbitrary patterning of nanostructured transition metals, metal oxides, and alloys



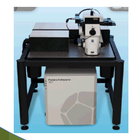
Example: Patterning of nanocrystalline Pt/Pd for...



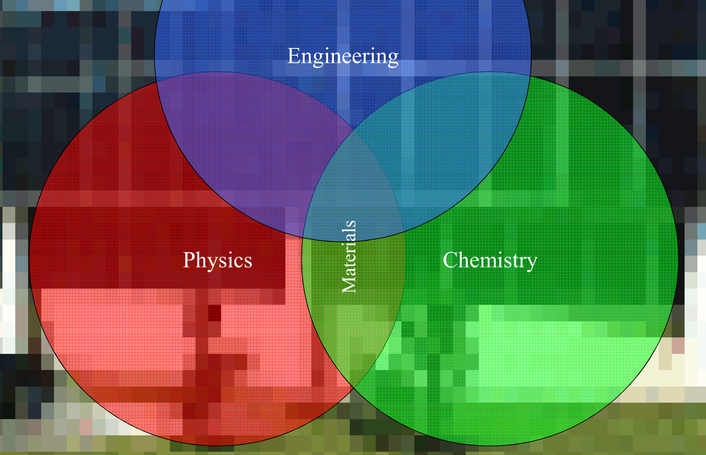
...autonomous micro-devices driven by environmental cues.



Nanocrystalline Pt confined in a asymmetric 3D hydrogel chamber directionally pumps micro-particles using environmental fuel Zarar, L. D.; Kaehr, B et al .JACS 2012, 134, 4007-4070.



The NanoScribe™ Maskless 3D Lithography Tool is a commercial instrument that greatly expands the 2photon lithography capabilities to the causal user.



Developing materials science and engineering technology in the National Interest

Research at the AML is focused on materials and process research in the areas of:

- ceramics,
- porous materials,
- catalysts,
- electronic materials,
- materials modeling,
- biomaterials,
- synthesis.

Strategic Advantages:

- Access to students
- Greater collaborations with UNM faculty
- Access to campus resources: equipment, library, computer
- Funding sources not available to Sandia (NSF)
- Joint purchase of novel instrumentation

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000