SAND2009-3698P

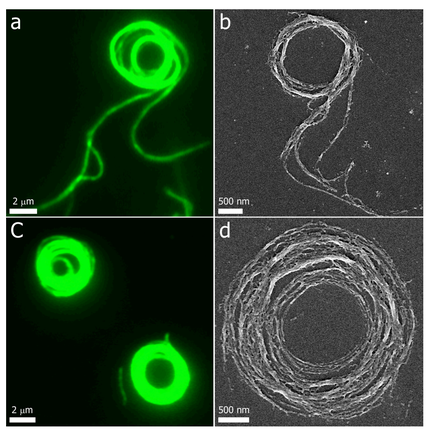
National Institute for Nano Engineering

Soft Nanomaterials and Nanocomposites

Organic materials at Sandia mediate critical element of assembly, integration, and communication between active nano-materials across multiple length scales.

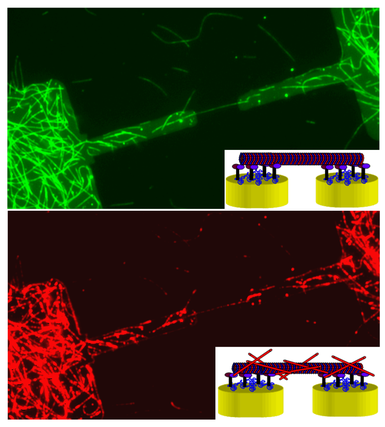
Biomaterials and Active Assembly

Motor protein-based transport of microtubules over a surface introduces dynamic forces that, when combined with chemical bonding between microtubules, drives the assembly of non-equilibrium, rotating rings.



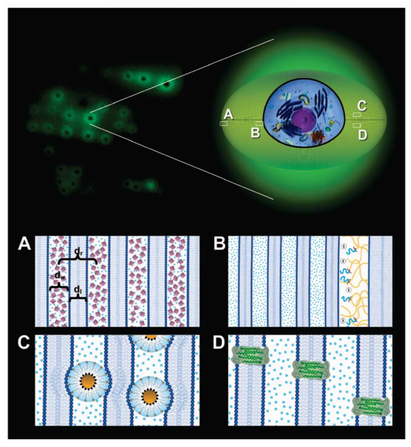
George Bachand (SNL/CINT)
Similar work by Henry Hess (U. Florida)

Interactions between surface chemistry, motor proteins and microtubules create biomolecular bridges that act as dynamic templates for materials such as the carbon nanotubes shown in the interconnect below.



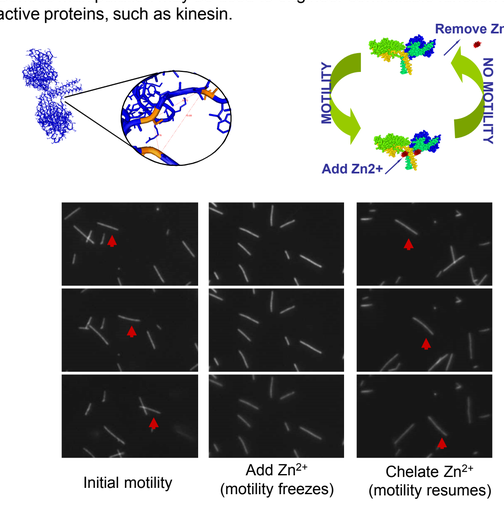
Erik Spoerke, Bruce Bunker (SNL/CINT)
Robert Haddon (UC-Riverside)

During encapsulation within a silica host matrix, live yeast cells surround themselves in a protective, multilamellar lipid vesicle that enables cells to remain viable within these living nanocomposites.



Jeff Brinker (SNL/UNM)

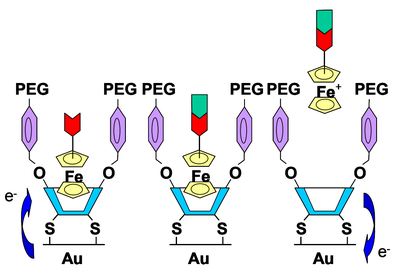
Genetic manipulation may be used to engineer controllable function into active proteins, such as kinesin.



George Bachand (SNL/CINT)

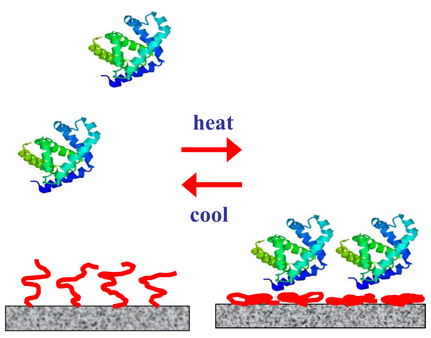
Surface Modification and Functionalization

Electrochemical activation of designer self-assembled monolayers controls molecular capture on surfaces



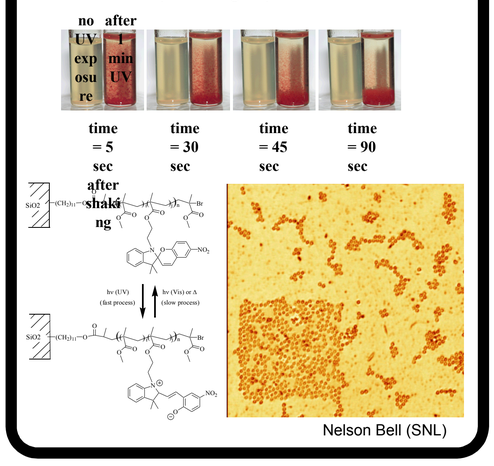
Bruce Bunker (SNL/CINT)

Thermally-responsive polymers (e.g. PNIPAM) moderate protein binding to surfaces by alternating between hydrophilic and hydrophobic states.



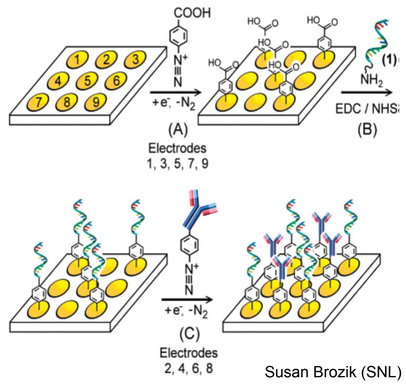
Dale Huber (SNL/CINT)

Photoactivated polymerization of surface-bound spyrobenzopyran enable reversible aggregation or patterning of particles



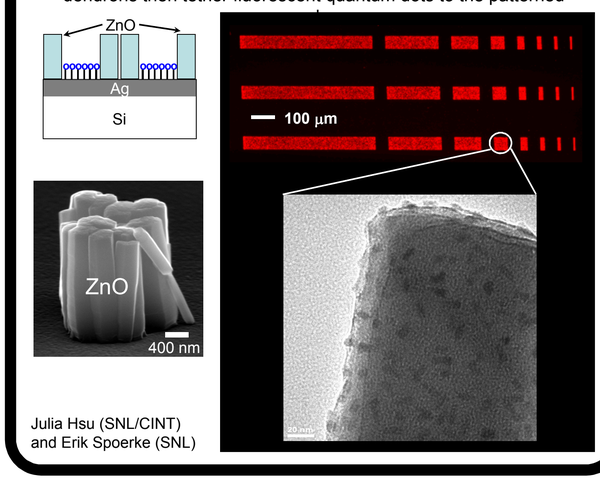
Nelson Bell (SNL)

Electroaddressable deposition of diazonium salts enables demonstration of simultaneous detection of DNA and protein on a single platform.



Susan Brozik (SNL)

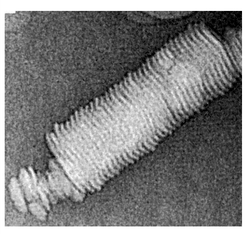
Soft lithography creates patterned self-assembled monolayers that direct the growth of patterned ZnO nanorod arrays. Custom peptide dendrons then tether fluorescent quantum dots to the patterned



Julia Hsu (SNL/CINT)
and Erik Spoerke (SNL)

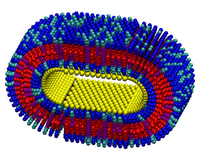
Self-Assembly and Nanoscale Templating

Functionalized lipid membranes can be assembled into unusual structures.



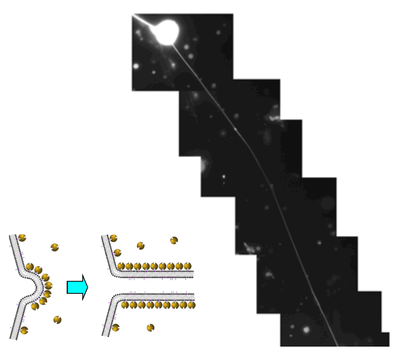
Darryl Sasaki (SNL)

Computation can be applied to design an understand such self-assembly schemes.



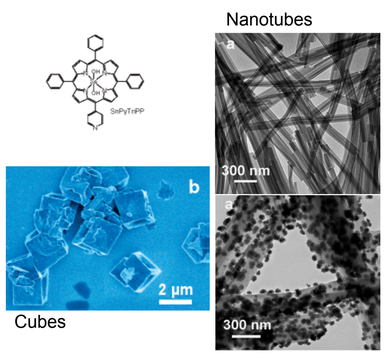
Mark Stevens (SNL/CINT)

Giant biotinylated lipid vesicles, treated with streptavidin, will spontaneously nucleate long tubular extensions.



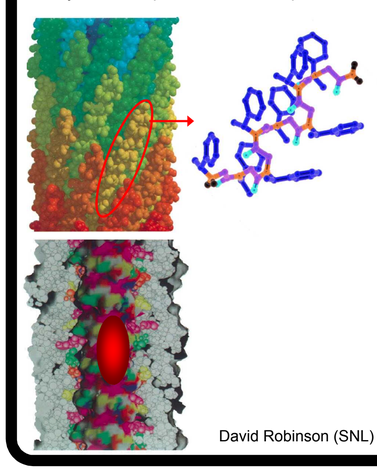
Darryl Sasaki (SNL)

Complex supramolecular architectures can be assembled from porphyrin building blocks. These nanostructures may serve as templates for nanoscale “self-metallization.”



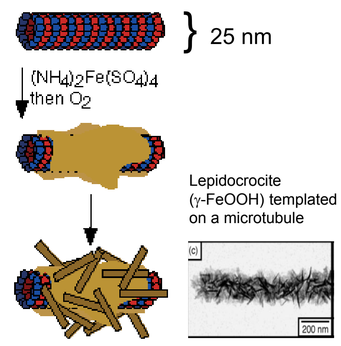
John Shelnutt (SNL/UNM)

Synthetic peptoid moieties may promote nanocrystal growth in biological or synthetic supramolecular templates.



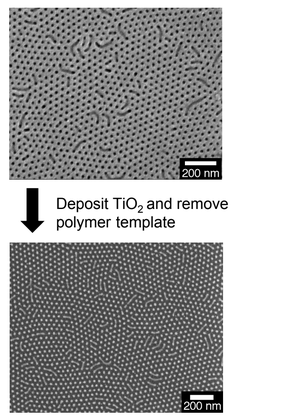
David Robinson (SNL)

Microtubules may serve as linear supramolecular templates for nanomaterials synthesis.



Andrew Boal (SNL)

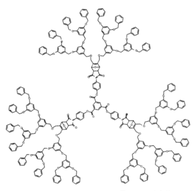
Diblock copolymers serve as templates for patterned nanoscale materials synthesis.



SNL, John Ekerdt, (UT-Austin)
Paul Nealey, Padma Gopalan, (U. Wisconsin)

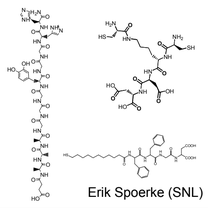
Custom Organic Synthesis

Thermoresponsive dendrimers are designed to reversibly disassemble



Dave Wheeler (SNL)

Engineered peptides mediate nanomaterial interactions

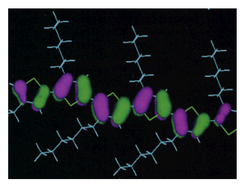


Erik Spoerke (SNL)

Custom synthesis can also provide opto-electronically active organics.

Anthradithiophene

John Anthony (U. Kentucky)
Matt Lloyd (SNL)

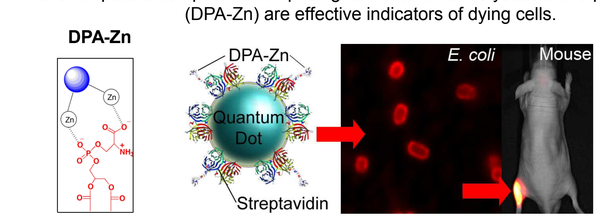


Poly(3-hexylthiophene)

Dave Wheeler, Tim Lambert (SNL)

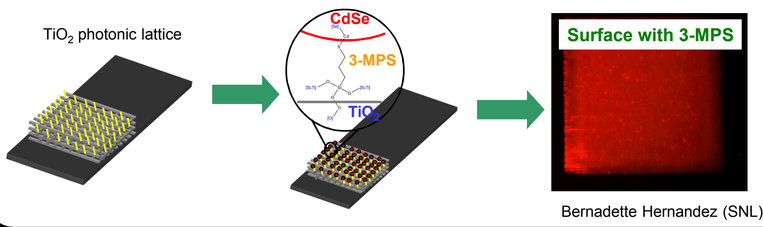
Nanoparticle Integration

Biocompatible composites comprising fluorescent nanocrystals and a protein mimic (DPA-Zn) are effective indicators of dying cells.



Brad Smith (U. Notre Dame)
Tim Lambert (SNL)

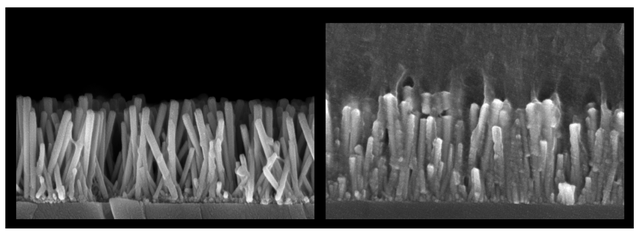
Molecular tethers incorporated into photonic crystal arrays bind functionalized nanocrystals to create photonically-complex composites.



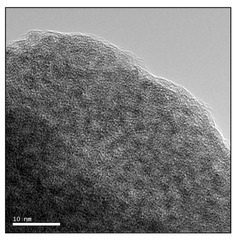
Bernadette Hernandez (SNL)

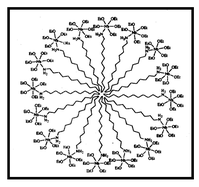
Active Material Composites

Conductive polymer(p3HT) infiltration into semiconducting nanorods (ZnO) creates promising photovoltaic composites.



Julia Hsu (SNL/CINT)





Functional surfactant-based templating of nanoporous ceramics create catalytically or electochemically active composites.

Erik Spoerke (SNL)

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy’s National Nuclear Security Administration under Contract DE-AC04-94AL85000

Sandia National Laboratories