Hybridized Nanostructures

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Our Goals

Produce hybrid nanostructures, for use in real world applications.

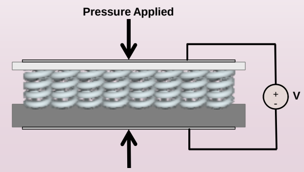
Possible applications are be new light trapping layers for next generation solar cells, 3D magnetic storage, and Terahertz receivers/transmitters.

- Pre-patterning substrates using nanospheres.
- Growth of nanostructures by GLAD deposition.
- Hybridization by magnetron sputtering.
- Characterize physical, electrical, optical properties, using SEM, TEM, ellipsometry, and other techniques.

Future Devices

- New communication devices for terahertz frequencies
- Novel biological sensors
- Light trapping for efficient solar cells
- Piezoelectric charging devices
- Magnetic memory
- Pressure sensors

Charge your phone as you walk!



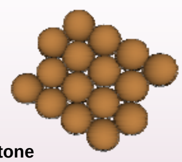
Hybridizing

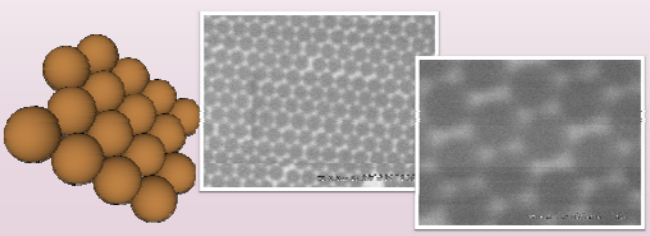
Pre-Pattering – Silica Nanospheres

Pre-Pattering is accomplished using self aligning silica nanospheres as a mask to create a hexagonal pattern.

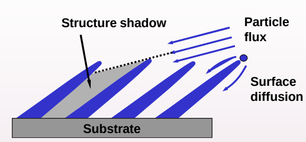
Steps for patterning:

- Substrate is cleaned in a plasma asher
- Microspheres are deposited on substrate
- Substrate is cleaned in plasma asher
- Gold or other material is deposited on top of mask
- Microspheres are removed in ultrasonic bath of acetone

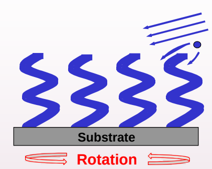




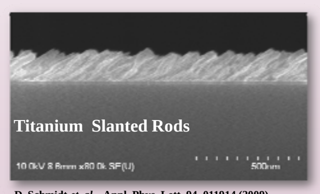
GLAD – Glancing Angle Deposition



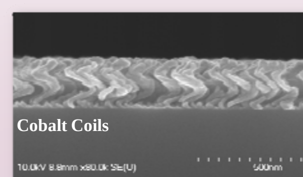
The incoming particle flux at glancing angle causes self-organized columnar growth due to shadowing and slow surface adatom movement.



Growth of nanospirals is achieved while the substrate is rotated around its normal during deposition process.



D. Schmidt *et. al.*, Appl. Phys. Lett. 94, 011914 (2009)



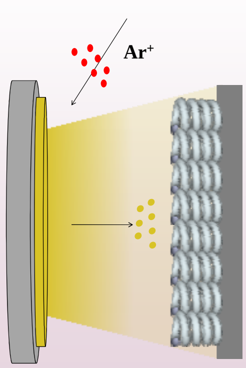
D. Schmidt *et. al.*, J. Appl. Phys. 105, (2009)

Magnetron Sputtering

Materials such as Zinc Oxide (ZnO) or Barium Titante (BTO) are deposited into the nanostructures using Magnetron Sputtering.

ZnO
- Large band gap ~3.3 eV
- Colorless and transparent
- Piezoelectric Properties
- Large electric fields

BTO
- Piezoelectric Properties
- Ferroelectric effect
- High Frequency applications

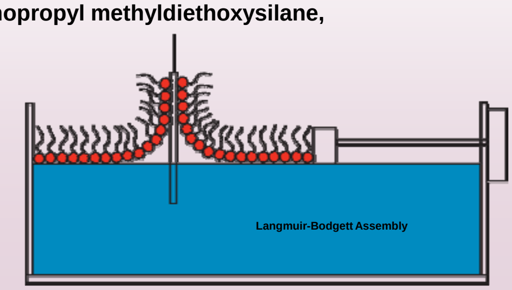


Future Work

Currently the method of depositing the nanospheres, creates a small area of mono layers used for patterning.

To solve this problem, Langmuir-Bodgett assembly which is a know reliable technique to prepare monolayers of nanoparticales will be tested.

Before the Langmuir-Bodgett assembly, Silica particles will be modified with aminopropyl methyldiethoxysilane, so as to terminate them with a positively charged amine group. This prevents agregation.



Graduate Research Symposium & Poster Session, E-WEEK, April 24th, 2009