

# MSE 566 Nanocrystalline Materials

Abdulaziz K. Assaifan, PhD

## Instructor contact Information:

Dr. Abdulaziz K. Assaifan

Mechanical Engineering Department, Bldg. 3, Rm GC 26

King Saudi University

Email: [Aassaifan@ksu.edu.sa](mailto:Aassaifan@ksu.edu.sa)

Office hours: TBC

## Course Topics:

- **Introduction to Nanotechnology:** The future of Moore's law, what is nanotechnology, why nanotechnology, existing applications of nanotechnology, nanocrystals, different dimensions of nanocrystals and properties of nanocrystals.
- **Nanofabrication:** "top-down" and bottom-up" nanofabrication, optical lithography techniques, electron beam lithography (EBL), focused ion beam (FIB), limitations of "top-down" lithography", nanoimprint, self-assembly, nano-manipulation, charge writing, dip-pen nanolithography, physical vapour deposition (PVD) and chemical vapour deposition (CVD). Printing and coating. Electrospinning.
- **Characterization at the nanoscale:** Different nanomaterials characterization techniques such as Scanning electron microscope (SEM), Transmission electron microscope (TEM), Scanning tunnelling microscope (STM) X-ray diffraction (XRD), Energy dispersive X-ray (EDX), Thermogravimetric analysis (TGA), Fourier Transform infrared analysis (FTIR), X-ray photo-electron spectroscopy (XPS), Atomic force microscopy (AFM), and Photoluminescence (PL).
- **Carbon Nanostructures:** Diamond, Graphene, Carbon Nanotubes and Fullerenes.
- **Metal oxide Nanostructures:** ZnO nanomaterials, Advantages, Properties, Fabrication, Dimensions, Limitations and Applications.
- **Functionalization and modification of nanocrystals:** Self-assembly, Self-assembled Monolayer (SAMs), Thiols, Siloxanes, Electrostatic attraction.
- **Recent advances in nanotechnology research:** A focus on uses of nanotechnology in Bio-applications, Electronics, Mechanical applications and Water Treatment Technologies.

## Grading Policy

Assignments -----	20
Project -----	20
One Major Exam -----	20
Final Exam -----	40

## Recommended Reading:

- "Introduction to Nanoscale Science and Technology", M. Di Ventra et al. (Ed.), Springer
- "Nanoscale Science and Technology", R. Kelsall et al. (Ed.), Wiley