

## ENGR 3501: Nanoscale Devices & Systems – Fall 2015 (Class # 20398)

**Timings:** T, Th: 3:30-4:45 PM

**Location:** MEC 214

**Instructor:** Nathan S. Swami, Associate Professor, Electrical & Computer Engineering

**Pre-requisite:** None other than first year calculus, physics and chemistry



### The first nanotechnologists

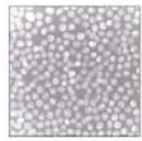
Ancient stained-glass makers knew that by putting varying, tiny amounts of gold and silver in the glass, they could produce the red and yellow found in stained-glass windows. Similarly, today's scientists and engineers have found that it takes only small amounts of a nanoparticle, precisely placed, to change a material's physical properties.

#### Gold particles in glass

Size\*: 25 nm  
Shape: sphere  
Color reflected:

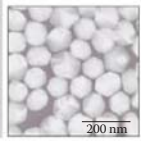


100 nanometers =  
0.0001 millimeter



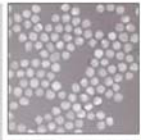
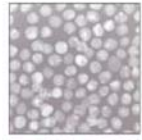
#### Silver particles in glass

Size\*: 100 nm  
Shape: sphere  
Color reflected:



Had medieval artists been able to control the size and shape of the nanoparticles, they would have been able to use the two metals to produce other colors. Examples:

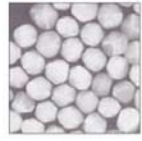
Size\*: 50 nm  
Shape: sphere  
Color reflected:



Size\*: 40 nm  
Shape: sphere  
Color reflected:



Size\*: 100 nm  
Shape: sphere  
Color reflected:



Size\*: 100 nm  
Shape: sphere  
Color reflected:



\*Approximate



**Course Description:** The ability to spatially localize, pattern and interconnect structures with nanoscale resolution is of tremendous significance towards emerging technologies within information systems, biomedicine and cognitive sciences. This course utilizes a hierarchical approach to survey various nanotechnologies, beginning with the emerging phenomena at the nanoscale; their device application for electronics, photonics, biosensing and tissue regeneration; the fabrication of integrated nanosystems; and finally their impacts on environmental systems. A chief feature of this course is that it will be coupled with the STS 3110 course to include a hands-on project-oriented activity on Societal Implications of Nanotechnology that integrates the technical and societal aspects. This course serves as a follow-up to ENGR 2500, but can be taken by itself without requiring the completion of ENGR 2500.

**Grading:** 5 Homework assignments, 2 mid-term exams and an integrative final project

**Textbooks:**

(1) Nanotechnology” Understanding Small Systems: Ben Rogers, Jesse Adams, & Sumita Pennathur, CRC Press

(2) Fabrication Engineering at the Micro and Nanoscale, Stephen Campbell, Oxford Press

**Topics:** Following are the succession of topics covered by this course:

1. Nanoscale phenomena: Survey of the physical, chemical and biological phenomena that emerge at the nanoscale
2. Nanoscale Devices for applications in electronics, photonics, materials, and mechanics
3. Nanoscale fluidics, biotechnology & medicine
4. Fabrication and integration of nano-devices into systems
5. Metrology, ultimate scaling limits and future directions
6. Nano-toxicology and Implications on Environmental Systems
7. Jointly with STS 3110: Simulation Project on Societal Implications\*

\* This activity will occur on Thursdays: 4:30-5:30 PM