University of Kentucky  
Department of Chemical and Materials Engineering  

MSE 632  
Advanced Materials Science  
Fall 2005  

Instructor:  Dr. Bruce Hinds  
ASTeCC 350  
(office hrs. W 1:00-2:30)  
email: bjhinds@engr.uky.edu  

Class Time:  T,TR  9:30-10:45  FPAT 253 (Anderson Tower)  
Credit Hours:  3  
Course Web Page:  http://courses.engr.uky.edu/CME/mse632/  

Required Text:  
Nanostructures & Nanomaterials, G. Cao Imperial College Press 2004*  
*The book may be purchased at Amazon.com or similar outlets. Numerous assignments will be based on this text and is hence required.  

Course Description:  Classification of solids, atomic structure and bonding, relation of structure to properties, deformation behavior and failure.  

Goals:  This course will focus on the learning of topics related to the synthesis and properties of nano-scale materials. Synthetic approaches will be related to fundamental surface science, nucleation and growth mechanism and thermodynamics. Chemical activity, electronic and mechanical properties of nanomaterial systems will be studied. Specific materials systems that result in nano-structured materials as well as a variety of nano-fabrication techniques will be surveyed and analyzed. Another critical goal of the course to demonstrate the process of in-depth learning of a current research topic from relatively shallow introductory text commonly found in emerging topic areas. This will be accomplished through utilizing literature sources in numerous in-class activities and analysis projects.  

Outcomes:  By successfully completing this course students will be able to:  
Describe and formulate synthetic routes to nano-scale material systems.  
Predict microstructure using surface energy, nucleation, and growth theories.  
Evaluate and compare proper characterization techniques related to chemical, structural, electronic, and mechanical properties of nano-scale materials.  
Prepare in-depth description of a sub-topic of a general introductory research text using outside literature sources and personal analysis.  
Formulate problems from introductory text and literature material allowing future self-instruction of new topics.  
Create and defend a novel scientific/engineering research proposal.
## Calendar and Topics

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tr>
<td>Aug. 25</td>
<td>Course outline and general introduction to nanotechnology</td>
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| Aug 30, Sept 1 | Practical utilization of information science   
                        | Electronic properties of quantum confined systems                                        |
| Sept. 6,8  | Electronic properties of quantum confined systems  
                        | Intro to band diagrams, electronic defects and molecular orbitals                        |
| Sept. 13,15 | Physical chemistry of surfaces                                                            |
| Sept. 20,22 | Nucleation and growth theory                                                              |
| Sept. 27,29 | Zero dimensional systems: Nanoparticle synthesis                                           |
| Oct. 4,6   | Nanoparticle synthesis  
                        | One dimensional systems: Nanowires and nanorods                                           |
| Oct. 11,13 | Nanowires and nanorods  
                        | (Mid-Term Exam, Oct. 13)                                                                   |
| Oct. 18,20 | Nanowires and nanorods  
                        | Two dimensional systems: Thin film processes                                               |
| Oct. 25,27 | Two dimensional systems: Thin film processes                                               |
| Nov. 3     | (Nov. 2 Election day no class)  
                        | Carbon Nanotubes                                                                          |
| Nov. 8,10  | NanoLithography and directed self-assembly                                                |
| Nov. 15,17 | Characterization                                                                         |
| Nov. 22    | Characterization  
                        | (Thanksgiving Vacation, 25th)                                                              |
| Nov. 29, Dec 1 | Nano-scale mechanical processes  
                        | Applications                                                                             |
| Dec. 6,8   | Research proposal presentations                                                           |

**Final Exam**  
**Thurs, Dec. 15, 8:00am**
Grading Policy:

- 20% Homework
- 20% In-class participation
- 15% Mid-Term Exam
- 25% Research proposal and presentation
- 20% Final Exam

A = above 90%  B = 80-90%  C = 70-80%  D = 60-70%  E = below 60%

- Total score for each assignment (i.e. 100%) will be the highest mark for each assignment. An ‘A’ will have to be within 10% of this mark. The instructor reserves the right to set a higher total score if the entire class performance is substandard.
- Any form of cheating or plagiarism will result in a failing grade for the course. If you have any questions about what constitutes plagiarism, please see me immediately. It is particularly easy to ‘cut and paste’ material directly from the web (It is also particularly easy for me to find it from web searches). It is required that you properly notate material sources.
- In class participation is a significant portion of the class. Examples of activities include solving in-class sample problems, 2 minute reports on assigned reading, role playing, group brainstorming on explanations of literature precedence, discussion of following-up on topics from previous lectures. These activities will REQUIRE THE TIMELY READING OF COURSE MATERIAL!!!