Mechanics Presentation by the American Society for Engineering Education for a presentation given at their 2001 annual meeting. In 2002 he received a Career Award from the National Science Foundation, Division of Civil and Mechanical Systems.

Donald Stone, University of Wisconsin, Madison

Donald Stone obtained his B.S. in Physics from the University of Texas at Austin in 1980 and his Ph.D. in Materials Science & Engineering at Cornell University in 1984. His work focused on hydrogen attack in steels. He continued at Cornell as a postdoctoral research working on the mechanical properties of small structures including wires in electronic packages, thin films, solder joints, and fibers in fiber-reinforced composites. He came to Wisconsin in 1988 to the Department of Materials Science & Engineering where he carries out research and publishes in the areas of plastic deformation and creep, fatigue and creep fatigue, fracture, nanoscale plasticity, and nanoscale fracture. He developed the first nanoindenter with a practical range of 150K to 400K and with low-drift characteristics. He has developed methods for analyzing nanoindentation data including nanoindentation creep to investigate strengthening mechanisms in thin films. He has taught courses in physical metallurgy, mechanical properties of materials, electronic packaging, and ceramics.

NSF Fellowships

NSF fellowships are available to professors, postdocs and Ph. D candidates from US universities. The fellowship consists of full tuition plus a travel allowance if applicable; see web site for an application form. In addition to the application form, please submit a two page vita in NSF format and a 200 word statement indicating why the short course will help your career **by July 15, 2003.**

Course Organization

Registration

Mail in the completed registration form with check or money order.

Registration Dates

Now – July 15, 2003

Course notes

The course notes will consist of all presentation materials, lecture notes and appropriate review papers.

Fees

The registration fee for the short course is as follows:

Monday and Tuesday: $1,200

Wednesday to Friday: $1,500

Monday to Friday: $2,000

An additional $200 fee will be added to late registrations received after July 11th, 2003.

Register by June 1st and receive a 20% discount.

The fee includes continental breakfast, coffee breaks, and lunch, each day plus a reception dinner on Monday and a banquet dinner on Thursday as well as course lecture notes.

Location

The course will be held at Northwestern University.

Accommodations

A block of rooms has been reserved at special rates for short course attendees at the Omni Hotel. To qualify for special rates, you must mention that you are attending the "NSF Summer Institute on Nano Mechanics and Materials" short course. Attendees should contact the hotel directly to make reservations **(847) 866-8700**. The rooms at the **special rate of $79** will only be held until July 11, 2003. Dorm housing is also available; please check http://www.northwestern.edu/housing/ for more information

Daily Schedule

The lectures start at 8 a.m. and end at 6 p.m.

For additional information, contact:

Ms. Charlotte Gill Letscher (847) 467-7909

summerinstitute@mail.mech.northwestern.edu or

Prof. Wing Kam Liu

http://tam.northwestern.edu/summerinstitute/Home.htm

NSF Summer Institute on Nano Mechanics and Materials *

Co-sponsored by: ASME, the Northwestern University NASA URETI BIMat Center, the Northwestern University Materials Research Center, the NU Nanoscale Science and Engineering Center and Northwestern University

Professor Wing Kam Liu (Director)
Professor Ted Belytschko (Co-Director)
Professor Yip-Wah Chung (Co-Director)
Northwestern University, Robert R. McCormick School of Engineering and Applied Science, 2145 Sheridan Rd. Evanston, IL 60208

* Funded by the Civil and Mechanical Systems Division, monitored and guided by Dr. Ken P. Chong.

A Short Course on Nanoscale Mechanical Characterization: The Theory and Practice of Contact Probe Techniques

Instructors:

Robert Carpick (University of Wisconsin at Madison)

Donald Stone (University of Wisconsin at Madison)

August 11 to 15, 2003

Registration Form

U.S. professors, postdocs and graduate students see other side for NSF Fellowships.

Name: _____

Title: _____

Address: _____

_____

City: _____State: _____

Zip Code: _____Country: _____

E-mail: _____

Affiliation (will be printed on your name tag)_____

Phone: (___)_____

Make check or money order payable to: Northwestern University

Send to: Attn: Wing Kam Liu

Northwestern University, Dept. of Mechanical Engineering, 2145 Sheridan Rd. Evanston, IL 60208

Institute Mission

- To identify and promote important areas of nanotechnology, and to create new areas of focus which will augment current nanotechnology research and development by universities, industries and government.
- To train future and practicing engineers, scientists and educators in the emerging areas of nanotechnology, nano-engineering, nano-mechanics, and nano-materials.
- To exchange new ideas, disseminate knowledge and provide valuable networking opportunities for researchers and leaders in the field.

The short courses will provide fundamentals and recent new developments in selected areas of nanotechnology. The material will be presented at a level accessible to BS graduates of science and engineering programs. Emphasis will be on techniques and theory only recently developed that are not available in texts or standard university courses. The instructors are well known for their research and teaching.

Program Outline

Monday Aug. 11 "Introduction and Background"

1. Overview of technological and scientific issues: nanomechanics today and tomorrow
2. The past: hardness testing, pin-on-disk, profilometry: successes and limitations, significance
3. Review of mechanics of materials
4. Elasticity, plasticity, viscoelasticity, fracture (LEFM), tribology (macro, micro, nano). Definition of terms, concepts
5. Review of mechanical properties of materials
6. Worked problems, review, questions, discussion

Tuesday Aug. 12 "Contact Mechanics"

0. Review from Monday, questions.
1. Contact mechanics
   a. Elasticity review
   b. Boussinesq problem
   c. Hertz problem
   d. Elastic-plastic problem
   e. Adhesive models & fracture mechanics
   f. Viscoelastic models
   g. Rough surfaces
2. Limitations on the continuum viewpoint
- scale effects
- when nano is important
- examples of importance in nanotechnology: ultrathin films, nanocomposites, atomic-scale friction

3. Properties of surfaces
- atomic structures
- surface nomenclature
- surface energy
- relaxation & reconstruction

Wednesday Aug. 13 "Nanoindentation"

0. Review from Tuesday, questions.
1. Basic concepts – what you can and can't do, when you should and shouldn't use it
2. Basic principles:
- definitions: hardness, modulus
- measurements of H, E
- measurements of creep properties
- measurements of other indices of material behavior

3. Instrumentation
- requirements (vibration, temperature...)
- typical configurations
- probes
- calibration (displacement, load)

4. Methods:
- machine compliance
- contact area determination: area function, contact stiffness, imaging methods, special correlations
- testing procedures (patience)
- modulus, hardness, creep

5. Common Pitfalls
- telltale data issues

6. Examples of successful research
7. Summary

Thursday Aug. 14 "Nanotribology with AFM"

0. Review from Wednesday, questions.
1. Basic concepts – what you can and can't do, when you should and shouldn't use it
2. Basic principles:
- definitions
- work of adhesion, shear strength, atomic scale wear
- velocity dependent effects, viscoelasticity

3. Instrumentation
- requirements (vibration, temperature, environment)
- typical configurations & operation modes (contact, tapping, force modulation, etc.)
- probes – choice of tips, tip characterization and treatment
- calibration (piezo displacement, load, lateral force)

4. Methods:
- work of adhesion
- friction *vs* load
- contact stiffness, contact area
- elastic/viscoelastic properties

5. Common Pitfalls
- telltale data issues
- dirty secrets of the AFM world

6. Examples of successful research
7. Summary

Friday Aug. 15 Examples and Discussion

0. Review from Thursday, questions.
1. More discussion of successful research
2. Problem solving/worked examples
3. Open discussion, questions

Course Credit and Pre-requisites

The total number of contact hours for the five day program is 27, and 2.7 CEUs.

There are certain pre-requisites for each topic. In order to maximize the learning experience, we will provide complete course materials to students prior to the class. Pre-requisite material will be reviewed briefly at the beginning of each course.

Instructors

Robert Carpick, **University of Wisconsin, Madison**

Robert Carpick obtained his B.Sc. in Physics from the University of Toronto in 1991. He was awarded a "1967 Science and Engineering Scholarship" from the National Science and Engineering Research Council of Canada for graduate studies and commenced his Ph.D. work in Physics at the University of California at Berkeley, graduating in 1997. During that time he received the Russell and Sigurd Varian Fellowship from the American Vacuum Society. He then spent two years as a Postdoctoral Appointee at Sandia National Laboratories (Albuquerque, NM) in the Surface and Interface Sciences Department, and the Biomolecular Materials and Interfaces Department. Prof. Carpick has been an Assistant Professor in the Engineering Physics Department at the University of Wisconsin-Madison since 2000. He carries out research and publishes in the areas of nanotribology, nanomechanics, nanostructured materials, and scanning probe microscopy development. He has taught courses in physics, statics, mechanics of materials, and has recently developed a new course in Micro- and Nanoscale Mechanics. He serves on the editorial board of Review of Scientific Instruments. In 2001 he was awarded Best Overall