Materials Science and Engineering Department

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Michael Dudley, Old Engineering Building 312 (631) 632-8500

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Old Engineering Building 314, Zip 2275 (631) 632-8484

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Chandrani Roy, Sr. Staff Assistant; Shauntae Smith, Staff Assistant

Degrees Awarded
M.S. in Materials Science and Engineering; Ph.D. in Materials Science and Engineering

Web Site
http://www.matscieng.sunysb.edu/

Materials Science and Engineering Department

The Department of Materials Science and Engineering offers graduate work leading to the Master of Science and Doctor of Philosophy degrees. The motivating philosophy of the graduate program is to provide the student with a broad synthesis of the theoretical and experimental techniques required to work with all classes of materials. Emphasis is placed on courses that unify the field in terms of fundamentals treated with sufficient depth to enable the student to make technological contributions in diverse areas of materials science and engineering. Laboratory and coursework are structured to provide programs for students who (1) are entering intensive basic research-oriented programs leading to Ph.D. or Master of Science degrees, (2) are currently employed and can complete their studies in the evening, or (3) are working in materials-related industries and can integrate their work experience into their degree requirements.

Industrial Cooperative Ph.D. Program: A special extramural Ph.D. degree program is offered by the Department of Materials Science and Engineering for highly qualified individuals working in an industrial materials research area. Candidates for this program must have met the graduate coursework requirements for the Ph.D. typically by earning a master’s degree. Doctoral research is generally done at the student’s place of employment, rather than on the University campus. Contact the Department for further information.

Bachelor of Science Degree/Master of Science Degree Sequential Program
An engineering science, engineering chemistry, or physics student may apply at the end of the junior year for admission to this special program, which leads to a Bachelor of Engineering or Bachelor of Science degree at the end of the fourth year and a Master of Science degree at the end of the fifth year. In the senior year, a student in the program takes six credits of graduate courses. In the fifth year, the student takes 24 credits, of which at least 18 credits are coursework and 6 credits are ESM 599 Research. The advantages of this program over the regular M.S. program is that a student may start his or her M.S. thesis in the senior year, and that he or she needs only 24 credits in the fifth year as opposed to 30 credits for a regular M.S. student. For details of the M.S. degree requirements, see the Graduate Program Director.

Admission requirements of Materials Science and Engineering Department

Admission is based on the Graduate Program Committee’s assessment of the applicant’s aptitude for research and the compatibility of his or her interests with the active research programs and capabilities of the Department. Applicants are advised to pay particular attention to their statements of purpose (page 3 of the application form). Minimum requirements, in addition to those of the Graduate School, are as follows:

A. A bachelor’s degree in engineering, mathematics, physics, chemistry, or a closely related area from an accredited college or university;

B. A minimum grade average of at least a B in all courses in engineering, mathematics, and science;

C. Results of the Graduate Record Examination (GRE) general test;

D. For non-native speakers of English, results of the TOEFL exam with a score of at least 600 (Paper), 250 (Computer) or 90 iBT for PhD applicants and 85 iBT for MS applicants and no sub-score should be below a 22.

E. Acceptance by both the Department of Materials Science and Engineering and the Graduate School.

Facilities of Materials Science and Engineering Department

Research Activities
Since its inception, the Department has had a strong research component, with a major emphasis in surface science and engineering. The Department has been successful in obtaining external funding for research and currently has the highest per capita faculty funding within the University. In 2003, the Department topped the list for research funding in the College of Engineering and Applied Sciences. The Department boasts more than $4 million in external funding for 15 total full-time faculty members. The Department hosts two main interdisciplinary centers, one on Polymers and the other on Thermal Spray. These centers offer a unique and rich environment for interdisciplinary graduate research and education.

Garcia Center for Polymers at Engineered: The Polymer Center, offers an interdisciplinary program aimed at studying the molecular basis of macroscopic phenomena. With funds from industrial partners, the NSF and the Department of Energy (DOE), research is conducted on polymer
dynamics, nanopatterning, thin film and interface engineering, surface modification, blends, polyelectrolytes, adhesion, block polymers, and wetting.

The Center for Thermal Spray Research: The Center for Thermal Spray Research (CTSR) conducts both applied and fundamental research on thermal spray technology, which involves melt spray formation of protective coatings and free standing forms. CTSR is a unique facility containing a vast array of industrial-level plasma and combustion spray devices. In 1999, CTSR’s research program received a significant boost through a $5 million award from the Defense Advanced Research Projects Agency (DARPA) to pursue revolutionary applications of thermal spray in electronics. Under the auspices of the Mesoscale Integrated Conformal Electronics initiative, CTSR has expanded its reach in the design, synthesis, and applications of thick film electronics and sensor materials. A new laboratory for both electronics fabrication and characterization has been set up.

Recent awards made to the faculty include two NSF Nanoscale Integrated Research Team awards (totaling $2 million), one concerning the use of metal oxide electronic noses for use as molecular and biological sensors, and the other concerning molecular electronics on the nanoscale.

The proximity to Brookhaven National Laboratory (BNL) and its advanced national facilities has been a major benefit to both faculty and students within the Department. Several faculty members hold guest appointments at BNL, while Brookhaven scientists participate in research and teaching within the Department. The DOE awarded the contract to manage BNL in 1998 to Brookhaven Science Associates, a consortium of other universities led by Stony Brook and the Battelle Memorial Institute. The University’s relationship with this premier research facility greatly enhances both the Department’s and Stony Brook’s research programs.

At BNL, the facilities available to the Department include particle accelerators for carrying out ion beam surface modification experiments and highly sophisticated surface analysis probes. The National Synchrotron Light Source (NSLS) is also located at BNL. As one of the participating research teams at NSLS, the Synchrotron Topography Research Group, centered in Stony Brook’s Department of Materials Science and Engineering, is using special X-ray methods to image nondestructively dislocation microstructures. This enables image-detailed descriptions of dislocation motion and structures attendant to crystal growth and plastic deformation and fracture, as well as to interesting materials behaviors. The topographic method is also being used in department-based studies of surface chemical reactivity. The Department recently was awarded a $1 million NSF Major Research Instrumentation grant to set up a center for crystal growth. The center is focused on developing capabilities for tackling the most challenging problems in crystal growth of novel advanced materials, and currently includes a high-pressure, high-temperature furnace for crystal growth of III-nitrides from solution-melts, a low-temperature CVD reactor for deposition of ZnO films, a two-zone high-temperature resistance-heater furnace for sublimation growth of ZnO, and a high-temperature RF reactor for SiC sublimation growth.

As a result of the University’s Engineering 2000 initiative, our ties with industry are growing stronger: faculty members are working with industry on joint research projects and submitting cooperative proposals to outside agencies. The Materials Science Department has led the effort in joint industry-University projects within the College of Engineering through the New York State Strategic Partnership for Industrial Resurgence (SPIR) program.

SPIR
Stony Brook’s own facilities include state-of-the-art low-energy electron diffraction LEED; a state-of-the-art scanning electron microscope and a transmission electron microscope, both equipped with analytical capabilities and the latest software for electron diffraction simulation and image processing; an atomic force microscope; and electron spectroscopy for chemical analysis (ESCA) IAES/SIMS Infrared Microscopy units, as well as central characterization facilities that include equipment for microanalysis and X-ray techniques. A well-equipped materials fabrication and processing facility within the department boasts a collection of furnaces capable of reaching 3,000ºC in controlled atmospheres or under vacuum, a resist-spinner, ellipsometer, contact angle goniometers, and a high-resolution Nomarsky metallurgical microscope with image processing capability.

The analytical electron facility of the Department consists of both scanning and transmission electron microscopes. The state-of-the-art Schottky Field Emission Scanning Electron Microscope (SEM) (LEO Gemini 1550) includes an In-Lens Secondary Electron Detector in addition to the standard E-T detector, and a Rutherford Backscatter Electron Detector. This SEM allows for high resolution imaging of the surfaces and cross-sections of all types of solid materials. It is also fully equipped with an EDS (energy dispersive X-ray spectroscopy) system using an EDAX detector that provides elemental compositions and X-ray maps of the various phases of the materials examined. Finally, the SEM includes an Electron-Backscattered Electron Diffraction (EBED) analysis system based on the TSL/EDAX orientation imaging and Phase-ID software that allows for nondestructive diffraction analysis and orientation imaging (texture analysis) of the grain structure of the surface of the specimens tested.

This facility also includes a digitally controlled Transmission Electron Microscope (Philips CM12), complete with EDS and PEELS (Parallelreading Electron Energy Loss Spectroscopy) facilities for detailed analytical studies. This tool allows for the direct observation of the “internal” structure of materials at resolutions as low as a few Å and for the determination of the crystal structure of their various components. There are also facilities for sample preparation for electron microscopy and microanalysis observations, including precision ion milling units (such as VCR Group XLA 2000).

Furthermore, advanced software for electron diffraction patterns simulation and image processing is available (e.g., Desktop Microscopist and Digital Micrograph).

Another research area that is emerging in the Department includes the development and testing of chemical sensors. A gas sensor testing facility is being set up in the Department, and it will be available shortly.

Other surface-related research involves studies of surface/environmental interactions. Using unique combinations of electron and ion spectroscopies, infrared and optical microspectroscopy and synchrotron based techniques; research is being conducted into corrosion behavior and corrosion inhibition of engineering alloys, degradation of paints and other coatings, remediation of contaminated surfaces, and surface
cleaning. Much of this work has included collaborations with other universities, industries, national laboratories, and government facilities such as the Army Research Laboratory, Weapons and Materials Directorate (Aberdeen, MD). An evolving area of collaborative research involves related studies of unique thin films and structures formed using femtosecond laser ablation. The structure of epitaxial surface monolayers is being studied using LEED; extension of this research is also performed at the NSLS. The preparation of thin films of magnetic metals is studied using ultrahigh-vacuum (UHV) molecular beam epitaxy (MBE) processing. These materials are used in the computer industry in disk storage devices. The magnetic properties of these materials are studied using a vibrating sample magnetometer (VSM) and magneto-optic Kerr effect (MOKE) spectroscopy. Research is also being performed on the chemical makeup of the newly discovered high-temperature superconductors. Novel methods of rapidly spraying such materials onto surfaces are being developed. Through a Department of Defense instrumentation program, a comprehensive thermal analysis and porosity laboratory has been set up within the Department.

Consistent with Stony Brook’s designated mission as a research center, the cornerstone of the Department’s academic program is the graduate work leading to the research-oriented M.S. and Ph.D. degrees. The Department has about 50 full-time, fully supported students and as many as 10 part-time students, most of who work in Long Island’s high-technology industries.

Requirements for the M.S. Degree in Materials Science and Engineering

In addition to the minimum requirements of the Graduate School, the requirements for the M.S. degree in the Department of Materials Science and Engineering can be satisfied by either one of the two following options:

**M.S. Non-Thesis Option**

A. **Election**

The election of this option must be made by the student upon admission to the program and is considered a terminal degree.

B. **Coursework**

1. A minimum of 30 graduate credits with a grade point average of 3.0 or better in all graduate courses taken is required to graduate. All credits must be from coursework.

2. The 30 credits must include the following three core courses: ESM 511 Thermodynamics of Solids; ESM 513 Strength of Materials; and ESM 521 Diffusion in Solids.

3. Only six credits of ESM 696 Special Problems in Materials Science are allowed.

4. All courses taken outside the Department require permission from the Graduate Program Director.

**M.S. Thesis Option**

A. **Election**

The election of this option must be made by the student upon admission to the program and is normally considered part of the Ph.D. sequence. Students may not transfer to the Non-Thesis Option while registered for a Thesis Master’s or a Ph.D. degree.

B. **Coursework**

1. A minimum of 30 graduate credits is required to graduate; 24 credits must be from coursework.

2. The 30 credits must include the following three core courses: ESM 511 Thermodynamics of Solids; ESM 513 Strength of Materials; and ESM 521 Diffusion in Solids.

3. The 30 credits must include six credits of ESM 599 Research.

4. Only six credits of ESM 696 Special Problems in Materials Science are allowed.

5. All courses taken outside the Department require permission from the Graduate Program Director.

C. **Thesis**

For the student who elects to complete a thesis for the M.S. degree, the thesis must be approved by three faculty members, at least two of whom are members of the Department of Materials Science and Engineering, including the research advisor.

D. **Final Recommendation**

Upon fulfillment of the above requirements, the Graduate Program Committee will recommend to the Dean of the Graduate School that the Master of Science degree be conferred or will stipulate further requirements that the student must fulfill.

E. **Transfer to Other Options**

Transfer to another degree option in the Department can be made only with the written permission of the Graduate Program Director.

Requirements for the Ph.D. Degree in Materials Science and Engineering

A. **Plan of Work**

Before completion of one year of full-time residence, the student must have selected a research advisor who agrees to serve in that capacity. The student will then prepare a plan of further coursework. This must receive the approval of the student’s advisor and of the Graduate Program Committee.
B. Coursework
1. An average grade of B or higher is required for all courses.
2. A minimum of 24 graduate course credits is required to graduate (excluding ESM 599, ESM 697, ESM 698, and ESM 699).
3. The 24 course credits must include the following three core courses: ESM 511 Thermodynamics of Solids; ESM 513 Strength of Materials; and ESM 521 Diffusion in Solids. If the student does not receive a minimum of a B in a core course, he or she may repeat that course one other time.
4. All students must complete ESM 501 Teaching and Mentoring Techniques and ESM 514, Technical Writing for Scientist. These 2 courses do not count towards the 24 graduate course credits required.
5. The student must pass at least three credits of ESM 698 Practicum in Teaching and six credits of ESM 699 Dissertation Research on Campus.
6. Only six credits of ESM 696 Special Problems in Materials Science are allowed.
7. All courses taken outside the Department require permission from the Graduate Program Director.
8. All PhD students must register for ESM 698 (Practicum in Teaching) for five (5) semesters.

C. Preliminary Examination
The preliminary examination must be taken before the beginning of the student’s fifth semester. This is an oral examination designed to test the student’s ability to utilize his or her materials science background to carry out research in a chosen field of study, and to make clear written and oral presentations of research. At least ten days prior to the examination, the candidate should submit a research proposal (10-15 pages) to the examiners that places the research in context and outlines a scenario for its completion. The student must have finished the required coursework for the PhD program prior to taking the oral exam.

The examination committee will consist of three(3) Materials Science and Engineering Department faculty members. If a second examination is required, it must be completed by the tenth week of the sixth semester.

D. Advancement to Candidacy
After the student has successfully completed all requirements for the degree, other than the dissertation, he or she is eligible to be recommended for advancement to candidacy. This status is conferred by the Dean of the Graduate School upon recommendation of the Chairperson and the Graduate Program Director.

E. Dissertation
The most important requirement of the Ph.D. degree is the completion of a dissertation, which must be an original scholarly investigation. The dissertation shall represent a significant contribution to the scientific literature, and its quality shall be compatible with the publication standards of appropriate and reputable scholarly journals. At least two semesters should elapse between the preliminary exam and submission of the dissertation.

F. Defense
The candidate shall defend the dissertation before an examining committee consisting of four members, including the research advisor, two members of the Materials Science and Engineering Department, and one member from outside the Department.

G. Time Limit
All requirements for the Ph.D. degree must be completed within seven years after completing 24 credit hours of graduate courses in the program.

Faculty of Materials Science and Engineering Department

Distinguished Professors
Chu, Benjamin, Ph.D., 1959, Cornell University: Structure and dynamics of supermolecular and polymeric systems, using laser-light scattering, fluorescence recovery after photo bleaching, transient electric birefringence, small-angle X-ray scattering with synchrotron radiation, and other spectroscopic techniques.
Herman, Herbert, Ph.D., 1961, Northwestern University: Protective coatings; thermal spray; composites; marine materials.
Rafailovich, Miriam, Ph.D., 1980, Stony Brook University: Polymeric liquids; phase transitions; thin film wetting phenomena; atomic force microscopy; ion, X-ray, and neutron scattering.
Sampath, Sanjay, Ph.D., 1989, Stony Brook University: Thermal spraying; protective coatings; functioning graded materials; thick film electronics and sensors.

Professors
Clayton, Clive R., Ph.D., 1976, Surrey University, England: Environmental degradation of materials; XPS; AES; dynamic and static SIMS; electrochemical analysis synthesis by ultra-fast laser ablation; RHEED; protective coatings.
Dudley, Michael, Chairperson. Ph.D., 1982, University of Warwick, England: Synchrotron topography; crystal defects; mechanical properties.
Jona, Franco P., Ph.D., 1949, Swiss Polytechnic Institute (E.T.H.), Switzerland: Surface physics; LEED.

Mahajan, Devinder, Ph.D., 1979, University of British Columbia: Inorganic chemistry; fuel cells; catalysis.

Sokolov, Jonathan C., Ph.D., 1983, Stony Brook University: Surface and interface properties of polymers and blends; phase transitions; neutron and X-ray scattering; EXAFS; SIMS.

Associate Professors
Gersappe, Dilip, Graduate Program Director. Ph.D., 1992, Northwestern University: Polymer theory and simulation.
Gouma, Pelagia-Irene (Perena), Ph.D., 1996, University of Birmingham, England: Advanced materials characterization; electron microscopy and microanalysis techniques; chemical sensors.
Halada, Gary, Ph.D., 1993, Stony Brook University: Electron spectroscopy; electrochemistry; surface engineering; optical spectroscopy; environmental remediation.

Assistant Professors
Gentleman, Molly, Ph.D. 2006, Materials-University of California Santa Barbara, Santa Barbara, CA 2006; structure-property relationships for structural inorganic materials, particularly as they pertain to the performance of ceramic coatings for harsh environments.
Koga, Tadanori, Ph.D., 1998, Kyushu University, Japan, Physics: green nanofabrication of polymer thin films; chemical recycling of waste plastics and methane hydrate as a future energy resource.
Meng, Yizhi, Ph.D., 2003, Cornell University: Designing novel biomaterials for tissue engineering is the focus of Dr. Meng’s research.
Orlov, Alexander, Ph.D., 2005, University of Cambridge, UK, Physical Chemistry: M.Phil. Chemistry University of Cambridge, UK; M.S.E. Engineering, University of Michigan, USA; M.E./B.E. Engineering, National Technical University, Ukraine. Materials for environmental applications; physical chemistry, environmental nanotechnology and photocatalysis.
Venkatesh, T.A.,Ph.D., 1998, Massachusetts Institute of Technology: Nanomaterials, Smart Materials, Materials for MEMS and biomedical applications.

Research Professor
Gambino, Richard, M.S., (ret) 1976, Polytechnic Institute of New York: Magnetic thin films; magneto-optical properties; Hall effect and magnetoresistance of magnetic metals; epitaxial growth of magnetic materials.

Adjunct Faculty
Adzic, Radoslav, PhD., 1974, University of Belgrade, Chemistry; Surface electrochemistry; electrocatalysis; direct energy conversion; fuel cells.
Allahverdiyev, Adil M., (M.D. PhD) a professor and the Director of Laboratory of Cell Culture and Tissue Engineering at Yildiz Technical University in Turkey.
Chidambaram, Dev, Ph.D., 2003, Stony Brook University: Corrosion science and surface analysis.
Czajkowski, Carl, Ph.D., 1996, Stony Brook University: Nuclear materials engineering.
Fortmann, Charles, PhD., 1985, Standford University: Solid State Physics; Protein Dynamics.
Reid-Green, J. Douglas, MS in Geology from Northeast Louisiana University: promoting sustainable development by designing and implementing remediation programs for industrial facilities in North America
Gu, Genda, Ph.D., 1989, Harbin Institute of Technology, Harbin, China; Materials Science & Engineering; Single crystal characterization and physical properties measurement; single crystal growth and solidification of oxide materials and metallic materials.
Huang, Xianrong, Ph.D., 1995, Nanjing University, China: X-ray typography.
Isaacs, Hugh, Ph.D., 1963, Imperial College of Science and Technology, University of London, England: electrochemical research.

Johnson, Peter, Ph.D., 1978, Warwick University, England: Physics;

Jones, Keith, Ph.D., 1955, University of Wisconsin, Madison: Physics.


Li, Qiang, 1991, Iowa State University at Ames: Energy and electronic materials; synthesis and characterization.

Liu, Ying, Ph.D. Stony Brook University

Pernodet, Nadine, Ph.D., 1996, Polymers, Institut Charles Sadron, Strasbourg, France: Physical chemistry and polymers


Samuilov, Vladimir, Ph.D., 1986, Belarus State University: Physics.

Szaladja, Frank, MS, 2006, Stony Brook University, Materials Science.

Tawfik, Hazem, P.E. and a Certified Manufacturing Engineer; Director of the Institute of Research and Technology Transfer (IRTT) at Farmingdale State College - State University of New York


Twiley, John, B.S., 1976, University of California, Riverside: Chemistry.

Uchimiya, Sophie Minori, Ph.D, 2005, Environmental Chemistry Department of Geography and Environmental Engineering: Research Chemist, USDA-ARS Southern Regional Research Center, New Orleans, LA

Welch, David O., Ph.D., 1964, University of Pennsylvania: Theoretical materials science; kinetics of diffusion; energetics; statistical mechanics; crystal lattice defects; equations of state phase equilibria; radiation effects.

Zaitsev, Vladimir, Ph.D., 1992, Moscow State University, Russia: Chemistry.

Zhu, Yimei, Ph.D., 1987, Nagoya University, Japan: Materials physics.

NOTE: The course descriptions for this program can be found in the corresponding program PDF or at COURSE SEARCH.