MATERIALS SCIENCE AND ENGINEERING (ENMA)

Graduate Degree Program
College: Engineering

Abstract
Materials Science and Engineering is an interdisciplinary program. Students from engineering and science disciplines receive a solid foundation in the physics and chemistry of materials, thermodynamics, and structure of materials, as well as the latest technological aspects of materials in today's manufacturing environment. Faculty research areas are mainly concentrated in the development of novel materials for today's electronics, energy, biomedical, and high tech industries. These materials may be bulk or thin film format and range from ceramics, semiconductors, metals, polymer, and biomaterials. Departmental faculty members are major participants in the University of Maryland Materials Science and Engineering Center (http://mrsec.umd.edu), the Maryland NanoCenter (https://www.nanocenter.umd.edu) and the University of Maryland Energy Research Center (http://www.umerc.umd.edu). For an overview of the Materials Science and Engineering Department, please visit Materials Science and Engineering Graduate Programs (http://www.mse.umd.edu/graduate/admissions).

Financial Assistance
Financial assistance in the form of teaching and research assistantships and sponsored fellowships are available to qualified students. Requests for financial assistance will be considered for Fall admission only.

Contact
Ichiro Takeuchi
Graduate Program Director
Department of Materials Science and Engineering
1242 Jeong H. Kim Engineering Building
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University of Maryland
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Website: http://www.mse.umd.edu

Admissions

General Requirements
- Statement of Purpose
- Transcript(s)
- TOEFL/IELTS/PTE (international graduate students: (https://gradschool.umd.edu/admissions/english-language-proficiency-requirements))

Program-Specific Requirements
- Letters of Recommendation (3)
- Graduate Record Examination (GRE)
- CV/Resume
- Publications/Presentations

The Department offers graduate study leading to the Master of Science (thesis or non-thesis options) and Doctor of Philosophy degrees. In addition, students enrolled in the Professional Master of Engineering program may choose Materials Science and Engineering as a program option. Graduate study is open to qualified students holding a bachelor's degree from accredited programs in any of the engineering and science areas. For detailed admissions and program information, please visit Materials Science and Engineering Graduate Programs (http://www.mse.umd.edu/graduate/admissions)

For more admissions information or to apply to the program, please visit our Graduate School website: www.gradschool.umd.edu/admissions

Application Deadlines

<table>
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<th>Type of Applicant</th>
<th>Fall Deadline</th>
<th>Spring Deadline</th>
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<tr>
<td>Domestic Applicants</td>
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<tr>
<td>US Citizens and Permanent Residents</td>
<td>30 Nov</td>
<td>28 Sep</td>
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| International Applicants |               |                |
| F (student) or J (exchange visitor) visas; A, E, G, H, I and L visas and immigrants | 30 Nov | 28 Sep |

Other Deadlines: Please visit the program website at http://www.mse.umd.edu

Requirements
- Materials Science and Engineering, Master of Science (M.S.) (https://academiccatalog.umd.edu/graduate/programs/materials-science-engineering-enma/materials-science-engineering-ms)

Facilities and Special Resources
Special equipment includes scanning and transmission electron microscopes; X-ray diffraction devices; image analysis and mechanical testing facilities; crystal growing, thin film deposition and analysis equipment; HPLC, GC, IR, and other sample preparation and analytical apparatus.

The Laboratory for Advanced Materials Processing (LAMP) in JM Patterson 2225 includes a class 1000 clean room for various kinds of thin film processing, particularly things difficult to accomplish in the NanoCenter's new FabLab clean room in the Kim Building. LAMP also features custom-designed ultraclean chemical vapor deposition (CVD) and atomic layer deposition (ALD) equipment as the basis for research in nano and atomic layer deposition (ALD) equipment as the basis for research in nano applications and manufacturing process prototyping, particularly with real-time chemical sensing for metrology and process control. A custom wafer-scanning electrical characterization facility enables resistance and capacitance mapping.

The Nano-Bio Systems Laboratory (NBSL) in JM Patterson 2229 adjoins LAMP and provides capability for biotech research, specifically in biomaterials processing and biomicrosystems development. It includes a Zeiss 310 laser confocal/fluorescence microscope, microfluidic chip testing for biomolecular reaction and cellular response experiments, biomaterials deposition, a Zyvex L200 nanomanipulator system for
life science studies, and mass spectrometry and ICP optical emission equipment.

The W. M. Keck Laboratory for Combinatorial Nanosynthesis and Multiscale Characterization in 1141 Kim Building houses several thin film deposition chambers for rapid exploration of novel functional materials. The combinatorial approach allows simultaneous investigation of large numbers of different samples. The combinatorial laser molecular beam epitaxy is used to perform atomic layer controlled combinatorial synthesis of functional materials. Atomically controlled growth of unitcells are monitored in-situ using electron diffraction.

The Advanced Imaging and Microscopy Laboratory (AIM), located in 1237 Jeong H. Kim Building, houses the most electron powerful microscopes within any university in the Washington, DC metro area. The facility has a Field-emission Transmission Electron Microscope (TEM) with 1.4 angstrom resolution and can generate chemical-composition maps of materials using Energy-Dispersive X-Ray Spectroscopy (EDS) or Electron Energy-Loss Spectroscopy (EELS). Also housed in the lab are a thermionic TEM with 2.0 angstrom resolution (capable of in-situ electrical measurements and in-situ observations between -183 C and 1000C) and an electron microprobe with five Wavelength-Dispersion X-Ray Spectrometers (WDS).

Equipment available at other facilities include a Lakeshore vibrating scanning magnetometer and a scanning Auger spectrometer.

For additional information about the department's research facilities, please visit the following webpage: Materials Science and Engineering Research (http://www.mse.umd.edu/research).

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### Faculty

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First/Middle Name</th>
<th>Graduate Faculty Status</th>
<th>Academic Credentials</th>
<th>Positions</th>
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</thead>
<tbody>
<tr>
<td>Al-Sheikhly Mohamad I.</td>
<td>Full Member</td>
<td>B.Sc., University of Baghdad, 1974; Ph.D., University of Newcastle, 1981.</td>
<td>Professor, Materials Science and Engineering Affiliate Professor, Bioengineering Affiliate Professor, Chemical Engineering</td>
<td>Professor, Materials Science and Engineering Affiliate Professor, Chemical Engineering</td>
</tr>
<tr>
<td>Ankem Sreeramamurti</td>
<td>Full Member</td>
<td>B.Eng.,K.R. Engineering College-University of Mysore, 1972; M.Eng., Indian Institute of Science-Bangalore, 1974; Ph.D.,Polytechnic Institute of New York, 1980.</td>
<td>Professor, Materials Science and Engineering</td>
<td>Professor, Materials Science and Engineering</td>
</tr>
</tbody>
</table>
Cui Jun Non-Member B.S., University of Minnesota, Twin Cities, 1992; M.S., 2000; Ph.D., 2002. Affiliate Assistant Professor, Materials Science and Engineering

Cumings John Full Member Ph.D., University of California, Berkeley 2002. Associate Professor, Materials Science and Engineering Assistant Professor, Chemical Physics

Eichhorn Bryan W. Full Member B.A., Rollins College, 1983; Ph.D., Indiana University-Bloomington, 1987. Professor, Chemical Physics Professor, Chemistry Affiliate Professor, Materials Science and Engineering Assistant Professor, Chemical Physics

Flatau Alison Full Member B.S., University of Connecticut, 1978; M.S., University of Utah, 1985, Ph.D., 1990. Professor, Aerospace Engineering Affiliate Professor, Materials Science and Engineering Affiliate Professor, Bioengineering Graduate Director, Aerospace Engineering

Kofinas Peter Full Member B.S., Massachusetts Institute of Technology, 1989; M.S., 1989; Ph.D., 1994. Professor, Chemical Physics Affiliate Professor, Materials Science and Engineering Affiliate Professor, Chemical Engineering Affiliated Professor, Chemical Physics

Kukla Maija M. Non-Member M.Sc., University of Latvia, 1993; Doctor of Science, University of Latvia, 1996. Adjunct Professor, Materials Science and Engineering

Lee Sang Bok Full Member B.S., Seoul National University, 1990; M.S., 1992; Ph.D., 1997. Professor, Chemical Physics Affiliate Professor, Chemistry Affiliate Professor, Materials Science and Engineering
<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Educational Background</th>
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<tbody>
<tr>
<td>Leite Marina</td>
<td>Full Member</td>
<td>B.S., Universidade Federal de Pernambuco, Recife, 2000; M.S., Universidade Estadual de Campinas, 2003; Ph.D., University of Brasilia, 2007.</td>
</tr>
<tr>
<td>Livingston Richard A.</td>
<td>Special Member</td>
<td>A.B., Dartmouth College, 1968; B.E., Dartmouth College, 1969; M.S. M.E., Stanford University, 1970; Ph.D., University of Maryland, 1990.</td>
</tr>
<tr>
<td>Lloyd Isabel K.</td>
<td>Full Member</td>
<td>B.S., Pennsylvania State University-University Park, 1975; Ph.D., Massachusetts Institute of Technology, 1980.</td>
</tr>
<tr>
<td>Martinez-Miranda Luz</td>
<td>Full Member</td>
<td>B.S., University of Puerto Rico-Rio Piedras/San Juan, 1977; B.Mus., 1979; M.S., 1979; Ph.D., Massachusetts Institute of Technology, 1985.</td>
</tr>
<tr>
<td>Mo Yifei</td>
<td>Full Member</td>
<td>B.S., Peking University, 2005; Ph.D., University of Wisconsin, 2010.</td>
</tr>
<tr>
<td>Nie Zhihong</td>
<td>Non-Member</td>
<td>Ph.D., University of Toronto, Canada, 2008.</td>
</tr>
<tr>
<td>Oehrlein Gottlieb</td>
<td>Full Member</td>
<td>B.S., Wurzburg University, 1976; Ph.D., SUNY-Albany, 1981.</td>
</tr>
<tr>
<td>Ouyang Min</td>
<td>Full Member</td>
<td>B.S., Peking University, 1995; M.S., Peking University, 1996; A.M., Harvard University, 1999; Ph.D., Harvard University, 2001;</td>
</tr>
<tr>
<td>Pate Brian D.</td>
<td>Adjunct Member</td>
<td>B.S., University of Virginia; Ph.D. Indiana University.</td>
</tr>
</tbody>
</table>
Rubloff Gary W. Full Member B.A., Dartmouth College, 1966; M.S., University of Chicago, 1967; Ph.D., 1971. Professor, Materials Science and Engineering Professor, Systems Engineering Affiliate Professor, Electrical and Computer Engineering Professor, Materials Science and Engineering

Salamanca-Riba Lourdes G. Full Member Ph.D., Massachusetts Institute of Technology. Professor, Materials Science and Engineering Professor, Chemical Physics

Shapiro Benjamin Full Member B.S., Georgia Institute of Technology, 1995; Ph.D., California Institute of Technology, 1999. Professor, Mathematics & Statistics, and Scientific Computation Associate Professor, Systems Engineering Affiliate Professor, Materials Science and Engineering

Silverman Joseph Full Member B.A., City University of New York-Brooklyn College, 1944; M.A., Columbia University, 1948; Ph.D., 1951. Professor Emeritus, Materials Science and Engineering

Sita Lawrence R. Full Member B.S., Carnegie-Mellon University, 1981; Ph.D., Massachusetts Institute of Technology, 1985. Professor, Chemical Physics Professor, Chemistry Affiliate Professor, Materials Science and Engineering

Smela Elisabeth Full Member B.S., University of Pennsylvania, 1985; M.S., 1987; Ph.D., 1992. Professor, Mechanical Engineering Affiliate Professor, Electrical and Computer Engineering Affiliate Professor, Materials Science and Engineering

Takeuchi Ichiro Full Member B.S., California Institute of Technology, 1987; Ph.D., University of Maryland-College Park, 1996. Professor, Materials Science and Engineering Affiliate Professor, Physics

Talin Albert Adjunct Member B.S., University of California, San Diego, 1989; Ph.D., University of California, Los Angeles, 1995. University Affiliate, Materials Science and Engineering

Wachsman Eric Full Member B.S., University of California, Berkeley, 1982; M.S., Stanford University, 1986; Ph.D., Stanford University, 1990. Professor, Materials Science and Engineering Professor, Chemical Engineering

Wuttig Manfred R. Full Member B.S., Technische Universität Berlin, 1955; M.S., 1958; Ph.D., 1962. Professor, Materials Science and Engineering
Zachariah Michael R. Full Member B.S., University of California, LA, 1979, M.S., University of California, LA, 1981, Ph.D., University of California, LA, 1986
Professor, Applied Mathematics & Statistics, and Scientific Computation
Professor, Chemical Engineering
Professor, Chemical Physics
Professor, Chemistry Affiliate
Professor, Materials Science and Engineering