

MATERIALS SCIENCE AND ENGINEERING, M.S.

The Department of Materials Science and Engineering offers opportunities for graduate study leading to the master of science and the doctor of philosophy degrees in materials science and engineering.

The department offers two distinct master of science programs. The named option program, Nanomaterials and Nanoengineering (<http://guide.wisc.edu/graduate/materials-science-engineering/materials-science-engineering-ms/materials-science-engineering-nanomaterials-nanoengineering-ms>), is an accelerated program that can be completed in one full year of study, and is designed for students wishing to pursue a career in industry or government. The traditional master of science program with no named option is designed for students wishing to conduct research during their program.

ABOUT MATERIALS SCIENCE AND ENGINEERING

Meeting many of the most critical challenges facing modern society requires advances in the materials that underpin new technologies. Examples include providing carbon-free and renewable energy, clean water, advanced medical treatments and devices, and sustainable materials manufacturing. New materials are also required for continued economic growth in areas as diverse as aerospace, computing, and sensors.

Materials scientists and engineers at UW–Madison work toward solutions to these problems via research in a wide variety of areas.

Research areas include ceramics, computational material science; composites; corrosion; electrical, optical, magnetic materials; growth and synthesis; joining; materials for energy; metals; materials characterization and microscopy; nanomaterials; phase transformations; photonics; polymers and biomaterials; materials for nuclear energy; quantum computing; self-assembly; semiconductors; structural materials and mechanical properties; surfaces and interfaces; sustainability; thin films; and wear.

More broadly, the field of materials science and engineering is in the middle of a revolution in how we design and deploy new materials. The old way is by trial and error, which involves laboratory testing of hundreds or thousands of candidate materials, which is costly and can take decades to develop a new materials and deploy it in practical technologies. The emerging new method leverages advances in computational materials science; materials databases, data science, and machine learning; and high throughput materials synthesis and characterization to achieve true design of materials. The goal is to develop and deploy new materials much more quickly and much lower cost than ever before. Materials design is a major theme of materials research on campus, organized around the areas of materials design via atomically controlled thin film systems, modular design of nanomaterials, and integrated experimental and computational materials engineering. Materials design and these themes cut across the research and application areas list above.

Materials research extends across campus, well beyond the boundaries of the Department of Materials Science and Engineering, so graduate students in materials can pursue research with a large number of affiliate faculty. Faculty emphasize the cross-cutting, interdisciplinary nature of materials research, which is also reflected by the diverse

undergraduate backgrounds of the student body, many of whom do not have undergraduate degrees in materials.

Materials research benefits from major campus facilities, including the Materials Science Center, the Wisconsin Microscopy and Characterization Center, Wisconsin Center for Applied Microelectronics, and the Soft Materials Laboratory. Research is supported by major centers, including the National Science Foundation Materials Research Science and Engineering Center and the Grainger Institute for Engineering.

Materials graduates from Wisconsin find long-term success in careers in private industry, national laboratories, and academia in the US and around the world.

ADMISSIONS

GRADUATE SCHOOL ADMISSIONS

Graduate admissions is a two-step process between academic degree programs and the Graduate School. Applicants must meet requirements of both the program(s) and the Graduate School. Once you have researched the graduate program(s) you are interested in, apply online (<https://grad.wisc.edu/admissions>).

Requirements	Detail
Fall Deadline	December 15
Spring Deadline	October 1
Summer Deadline	December 15
GRE (Graduate Record Examinations)	Required.
English Proficiency Test	Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (https://grad.wisc.edu/apply/requirements/#english-proficiency).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

Applicants normally are expected to have a B.S. in the physical sciences or engineering. Undergraduate studies normally would include mathematics through differential equations, at least one year each of general physics and chemistry, a course in physical chemistry or modern physics, and an elementary course in properties of materials. Applicants may be admitted with deficiencies. These must be made up as soon as possible after entering the program.

IMPORTANT APPLICATION INFORMATION

Admission to the University of Wisconsin–Madison Graduate School (<http://grad.wisc.edu>) is a prerequisite for admission to study materials science. A minimum GPA of 3.0/4.0 is required. Graduate Record Examinations (<http://www.ets.org/gre>) scores on the General Test are required. Admission is highly selective. Most admitted students have an undergraduate GPA above 3.5. Mean GRE scores in the most recent admission cycle were quantitative: 166, verbal: 163, and analytical writing: 3.5. However, full consideration will be given to all students

meeting the UW–Madison graduate school requirements. Please use institution code: 1846; no department code is necessary.

Foreign students must submit satisfactory results on the TOEFL (<http://www.ets.org/toefl>) or another acceptable English Language Test. Please use institution code: 1846; no department code is necessary. Information about these exams can be obtained from the Educational Testing Service, Princeton, New Jersey 08540 or Berkeley, California 94704.

Please use the online application (<https://apply.grad.wisc.edu/Account/Login?ReturnUrl=%2f>) to begin your application. To be considered for fellowships, all application materials are due by January 1. If you have questions about the application or admissions process, please do not hesitate to email msaegradadmission@engr.wisc.edu.

The graduate school offers a limited number of application fee grants (waivers of all or part of the application fee) that are available in a few specific circumstances. Further information is available here. (<https://grad.wisc.edu/admissions/feegrants>)

#Submit only the documents requested.

NOTE: PLEASE DO NOT SEND DOCUMENTS TO THE GRADUATE SCHOOL. ALL DOCUMENTS SHOULD BE UPLOADED WITH YOUR APPLICATION.

APPLICATION DEADLINES:

Spring semester: October 1

Fall semester: December 15

QUESTIONS?

Check out the Admissions FAQ or contact us at msaegradadmission@engr.wisc.edu.

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (<https://grad.wisc.edu/funding>) is available from the Graduate School. Be sure to check with your program for individual policies and processes related to funding.

PROGRAM RESOURCES

FINANCIAL ASSISTANCE

Please note that most funding is available for Ph.D. students and there is limited resources for M.S. students. International students must prove one year of funding before requesting assistance. Financial assistance is not available for students enrolled in the named option M.S. in Nanomaterials and Nanoengineering (<http://guide.wisc.edu/graduate/materials-science-engineering/materials-science-engineering-ms/materials-science-engineering-nanomaterials-nanoengineering-ms>).

Various types of financial assistance are available for entering graduate students, including research assistantships, teaching assistantships, fellowships and special grants. Decisions regarding financial support are made on the basis of letters of recommendation, grades, GRE general test scores, and, for research assistantships, the matching of the interests or experience of the applicant to the research programs of individual faculty members. January 1 is the deadline for receipt of fellowship applications.

Foreign students are generally not eligible for university fellowships. Applications for other types of support are accepted until mid-February.

RESEARCH AND TEACHING ASSISTANTSHIPS

Research assistantships (RAs) are available in any materials science area. These appointments are under the supervision of the major professor directing the research. Students interested in research assistantships in a particular area are encouraged to contact professors whose work is of special interest. The faculty's research interests are given in the Department of Materials Science and Engineering faculty section. An RA permits the most rapid progress toward a degree. Research assistantships in materials science graduate students are comparable to similar stipends from other institutions. Information about stipends can be obtained from the director of graduate studies, dgs@mse.wisc.edu.

Teaching assistantships involve teaching rather than research experience. They pay approximately the same as research assistantships. Teaching experience is especially desirable for students considering an academic career. The Department of Materials Science and Engineering supports a limited number of teaching assistantships, which are allocated after admissions. Applications for teaching assistantship positions for the 2018–2019 academic year are available here (https://docs.google.com/document/d/1-L8U7xhNQ9i-FOJbk0gJA67H8tZzC09qRytlDeGZ_Io/edit).

FELLOWSHIPS

Herb Fellowships in Materials Science are given out each year. The Herb Fellowship is a one-year full-ride fellowship for incoming graduate students. It is intended to provide especially strong students extra flexibility and independence in formulating their graduate research program.

Fellowships supporting graduate education are also offered on a competitive basis by organizations such as the National Science Foundation (<http://www.nsf.gov>), the Hertz Foundation (<http://www.hertzfndn.org>), UW–Madison Graduate School (<http://www.wisc.edu/grad>), the U.S. Department of Defense and a number of industries and foundations. Because some of these fellowships have fall application deadlines, early application is necessary. GRE scores for the General Test are required for fellowship applications.

OTHER FUNDING INFORMATION

If you choose to attend UW-Madison and plan to pursue funding on your own, the following sites could be very helpful:

- Graduate School Funding Resources (<https://grad.wisc.edu/studentfunding/prospective>)
- Graduate School Costs and Funding (<https://grad.wisc.edu/studentfunding/currentstudents>)
- Tuition & Fees (https://registrar.wisc.edu/tuition_&_fees.htm)

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (<http://guide.wisc.edu/graduate/>)

#policiesandrequirements text), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Evening/Weekend: These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.

Online: These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

Hybrid: These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

Accelerated: These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

CURRICULAR REQUIREMENTS

Requirements Detail

Minimum 30 credits

Credit Requirement

Minimum 16 credits

Residence Credit Requirement

Minimum Graduate Coursework Requirement Half of degree coursework (15 credits out of 30 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university's Course Guide (<https://registrar.wisc.edu/course-guide/>).

Overall 3.00 GPA required.

Graduate GPA Requirement

Other Grade Requirements The Graduate School requires an average grade of B or better in all coursework (300 or above, not including research credits) taken as a graduate student unless conditions for probationary status require higher grades. Grades of Incomplete are considered to be unsatisfactory if they are not removed during the next enrolled semester.

Assessments and Examinations Students must prepare a Master's thesis, present it in a public seminar, and defend it in closed examination by their Master's committee. The format and procedures must conform to the Graduate School rules for a Master's thesis, currently found at <http://grad.wisc.edu/currentstudents/mastersthesis>.

Language Requirements None.

REQUIRED COURSES

Code	Title	Credits
M S & E 900	Materials Research Seminar ¹	1
M S & E 530	Thermodynamics of Solids ²	3
M S & E 551	Structure of Materials ²	3
M S & E 521	Advanced Polymeric Materials ²	3
E P/E M A 547	Engineering Analysis I ²	3
CBE 660	Intermediate Problems in Chemical Engineering ²	3
MATH 703	Methods of Applied Mathematics 1 ²	3
MATH 704	Methods of Applied Mathematics-2 ²	3
PHYSICS 721	Theoretical Physics-Electrodynamics ²	3
M S & E 752	Advanced Materials Science: Phase Transformations ²	3
Select two materials electives ³		
M S & E 790	Master's Research or Thesis ⁴	13

¹ Take two semesters.

² Take three materials core course, chosen from these options.

³ Electives are to be selected from the list below.

⁴ MS&E graduate students are required to take at least 13 credits of research study.

Elective Courses:

Code	Title	Credits
M S & E 401	Special Topics in Materials Science and Engineering	1-3
M S & E/CHEM 421	Polymeric Materials	3
M S & E/N E 423	Nuclear Engineering Materials	3
M S & E/N E 433	Principles of Corrosion	3
M S & E 434	Introduction to Thin-Film Deposition Processes	3
M S & E/M E 435	Joining of Materials: Structural, Electronic, Bio and Nano Materials	3
M S & E 441	Deformation of Solids	3
M S & E 448	Crystallography and X-Ray Diffraction	3
M S & E 451	Introduction to Ceramic Materials	3
M S & E 456	Electronic, Optical, and Magnetic Properties of Materials	3
M S & E 461	Advanced Metal Casting	3
M S & E/M E 462	Welding Metallurgy	3

M S & E 463	Materials for Elevated Temperature Service	3
M S & E 465	Fundamentals of Heat Treatment	3
M S & E 521	Advanced Polymeric Materials	3
M S & E 530	Thermodynamics of Solids	3
M S & E/E M A 541	Heterogeneous and Multiphase Materials	3
M S & E 551	Structure of Materials	3
M S & E 553	Nanomaterials & Nanotechnology	3
M S & E 560	Fundamentals of Atomistic Modeling	3
M S & E 570	Properties of Solid Surfaces	3
M S & E 748	Structural Analysis of Materials	3
M S & E 750	Imperfections and Mechanical Properties	3
M S & E 752	Advanced Materials Science: Phase Transformations	3
M S & E 756	Structure and Properties of Advanced Electronic Materials	3
M S & E 760	Molecular Dynamics and Monte Carlo Simulations in Materials Science	3
M S & E 803	Special Topics in Materials Science	1-3
B M E/PHM SCI 430	Biological Interactions with Materials	3
B M E/M E 615	Tissue Mechanics	3
BIOCHEM/CHEM 704	Chemical Biology	2
CBE 540	Polymer Science and Technology	3
CBE 747	Advanced Colloid and Interface Science	3
CHEM 652	Chemistry of Inorganic Materials	3
CHEM 653	Chemistry of Nanoscale Materials	3
CHEM 621	Instrumental Analysis	3-4
CHEM 654	Materials Chemistry of Polymers	2-3
CHEM 664	Physical Chemistry of Macromolecules	2-3
E C E 745	Solid State Electronics	3
GEOSCI 765	Crystal Chemistry	3
PHYSICS 415	Thermal Physics	3
PHYSICS 551	Solid State Physics	3
PHYSICS 715	Statistical Mechanics	3
PHYSICS 751	Advanced Solid State Physics	3

The same course may not satisfy more than one requirement. For example, if M S & E 530 Thermodynamics of Solids is taken as a materials core course, it could not be used as a materials elective course. In addition, only one mathematics course may be counted as a materials core or materials elective course. Students or faculty may request that a course be added to the list by submitting a letter to the department graduate secretary including the course syllabus and explaining why the course is a materials-centric course.

NAMED OPTIONS (SUB-MAJORS)

A named option is a formally documented sub-major within an academic major program. Named options appear on the transcript with degree conferral.

View as listView as grid

- **MATERIALS SCIENCE AND ENGINEERING: NANOMATERIALS AND NANOENGINEERING, M.S.** ([HTTP://GUIDE.WISC.EDU/GRADUATE/MATERIALS-SCIENCE-ENGINEERING/MATERIALS-SCIENCE-ENGINEERING-MS/MATERIALS-SCIENCE-ENGINEERING-NANOMATERIALS-NANOENGINEERING-MS](http://guide.wisc.edu/graduate/materials-science-engineering/materials-science-engineering-ms/materials-science-engineering-nanomaterials-nanoengineering-ms))

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (<https://grad.wisc.edu/acadpolicy>) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES GRADUATE PROGRAM HANDBOOK

The Graduate Program Handbook (https://www.engr.wisc.edu/app/uploads/2016/01/MSE-Graduate-Curriculum-adopted-01_26_16-corrected-7-12-17.pdf) is the repository for all of the program's policies and requirements.

PRIOR COURSEWORK

Graduate Work from Other Institutions

With program approval, students are allowed to count graduate coursework from other institutions toward the minimum graduate degree credit requirement and the minimum graduate coursework (50%) requirement. No credits from other institutions can be counted toward the minimum graduate residence credit requirement. For additional requirements, consult the program.

UW–Madison Undergraduate

Typically, no credits from undergraduate coursework may be counted toward graduate program requirements. However, with program approval, students are allowed to count up to 7 credits numbered 300 or above toward the minimum graduate degree credit requirement when taken in excess of the undergraduate degree requirements; if that coursework is numbered 700 or above it may be used to satisfy the minimum graduate coursework (50%) requirement. No credits can be counted toward the minimum graduate residence credit requirement.

UW–Madison University Special

Typically, no UW–Madison University Special student credits may be counted toward graduate program requirements. However, with program approval, students are allowed to

count up to 15 credits of coursework numbered 300 or above taken as a UW–Madison Special student toward the minimum graduate residence credit requirement, and the minimum graduate degree credit requirement; if that coursework is numbered 700 or above it may satisfy the minimum graduate coursework (50%) requirement.

PROBATION

The Graduate School regularly reviews the record of any student who earned grades of BC, C, D, F, or Incomplete in a graduate course (300 or above), or grade of U in research credits. This review could result in academic probation with a hold on future enrollment or in being suspended from the Graduate School.

ADVISOR / COMMITTEE

Every graduate student is required to have an advisor. An advisor is a faculty member, or sometimes a committee, from the major department responsible for providing advice regarding graduate studies. An advisor generally serves as the thesis advisor. In many cases, an advisor is assigned to incoming students. To ensure that students are making satisfactory progress toward a degree, the Graduate School expects them to meet with their advisor on a regular basis.

Students without a researcher advisor at the end of their first year enrolled are in danger of failing to make adequate progress towards their degree. Students can be suspended from the Graduate School if they do not have an advisor.

CREDITS PER TERM ALLOWED

15 credits

TIME CONSTRAINTS

The Master's degree is typically completed within three years.

Master's degree students who have been absent for five or more consecutive years lose all credits that they have earned before their absence. Individual programs may count the coursework students completed prior to their absence for meeting program requirements; that coursework may not count toward Graduate School credit requirements.

OTHER

n/a

PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (<https://grad.wisc.edu/pd>) to build skills, thrive academically, and launch your career.

PROGRAM RESOURCES

Find information about professional development from the College of Engineering at the following webpage: <https://epd.wisc.edu/>.

LEARNING OUTCOMES

1. Demonstrate a strong understanding of mathematical, scientific, and engineering principles in the field.
2. Demonstrate an ability to formulate, analyze, and solve advanced engineering problems.
3. Demonstrate creative, independent problem solving skills.
4. Apply the latest scientific and technological advancements, advanced techniques, and modern engineering tools to these problems.
5. Recognize and apply principles of ethical and professional conduct.

PEOPLE

FACULTY:

Professors:

Mike Arnold, Sue Babcock, Chang-Beom Eom, Paul Evans, Padma Gopalan, Sindo Kou, Rod Lakes, Dane Morgan, John Perepezko, Ian Robertson, Don Stone, Izabela Szlufarska, Paul Voyles, and Xudong Wang.

Assistant Professors:

Dawei Feng, Jason Kawasaki and Jamian Hu.

AFFILIATE FACULTY:

Matt Allen, Randolph Ashton, John Booske, Dan Botez, Victor Brar, Weibo Cai, Adrien Couet, Steven Cramer, Wendy Crone, Mark Eriksson, Melih Eriten, Pupa Gilbert, Randall Goldsmith, Shaoqin Sarah Gong, Sundaram Gunasekaran, Robert Hamers, Hongrui Jiang, Song Jin, Mikhail Kats, Irena Knezevic, Tom Kuech, David Lynn, Zhenqiang Jack Ma, Kristyn Masters, Luke Mawst, Robert McDermott, William Murphy, Dan Negrut, Tim Osswald, Sean Palecek, Frank Pfefferkorn, Jess Reed, Mark Rzechowski, Majid Sarmadi, Raluca Scarlet, J. Leon Shohet, Kumar Sridharan, Darryl Thelen, Ramathanas Thevamaran, Lih-sheng Turng, Bu Wang, Amy Wendt, Justin Williams, Huifang Xu, and Zongfu Yu