The field of materials science and engineering is the study of “condensed matter” (that is, solids and liquids), and how an understanding of materials can be applied to fabricating devices and structures of utility. A relatively young discipline, materials science is an outgrowth of two traditional areas: the study of matter (and its structure-property relationship) that originated in chemistry and physics, and developments in various “materials” engineering fields (notably, microelectronics, metallurgy, ceramics, and plastics). More generally, materials scientists and materials engineers explore the inter-dependence of how a material is processed, its structure, and its properties, and how these impact material performance.

Two comprehensive majors are offered: Materials Science and Engineering, and Materials Science. Both majors are designed to give students a strong foundation in fundamental sciences and mathematics.

Department Honors in Materials Science

Eligibility – All students majoring in Materials Science or Materials Science and Engineering are invited to apply. Students should have a resident GPA and an overall GPA of 3.50 or higher. Student should also have a GPA of 3.50 or higher in their Materials Science or MS&E major, and meet the Program’s “High Impact” experience requirements (described below).

Application Procedure and Requirements – Submit an application form (available in the Program office) after completing four semesters at UW-EC, but no later than the students’ graduation semester (e.g., during the Spring semester for a May graduate). A Materials Science faculty member familiar with the student’s work (i.e., the students’ faculty advisor, research advisor, etc.) must endorse the application. In addition to the GPA requirements listed above, students submit evidence to the supporting faculty member that at least two High Impact experiences (of the seven) listed below have been completed; completing one of the seven experiences twice is not sufficient for Department Honors.

1. a summer research experience off campus as part of a federal program (NSF, NIST, DoD, DoE, etc.)
2. an appropriate internship in Materials Science or related area
3. a Study Abroad experience or Domestic Intercultural Immersion experience
4. an appropriate ‘professional’ presentation, which can be met by either:
   a. any presentation at an off-campus conference
   b. an oral presentation at CERCA, the Provost’s Honors Symposium, the WiSys Quick Pitch, or an accepted talk at the Materials Science Seminar Series
5. a faculty/student collaborative research project (that includes a poster presentation at CERCA)
6. a publication in a peer-reviewed journal
7. other immersive experience that is approved by the Materials Science faculty for departmental honors

Faculty

Douglas Dunham, Academic Program Director
Liz Glogowski
Matt Jewell

Douglas Dunham, Materials Science and Engineering Center (MSEC) Director
Professional Staff, MSEC:
Laurel McEllistrem
Anthony Wagner

Ying Ma
Marcus McEllistrem
Michael Walsh

Materials Science (MSCI)

MSCI 291 Special Topics in Materials Science (1-3 crs)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115; PHYS 232; MSE 221
Consent: Instructor Consent Required
- Field trips optional. A total of no more than nine credits from MSCI 291 and MSCI 491 may be applied toward major or graduation.

MSCI 384 Materials Science Junior Seminar I (0.5 crs)
Prerequisite: Minimum junior standing
Career preparation for Materials Science majors. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSCI 385 Materials Science Junior Seminar II (0.5 crs)
Prerequisite: MSCI 384
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSCI 384 Materials Science Junior Seminar I (0.5 crs)
Prerequisite: Minimum junior standing
Career preparation for Materials Science majors. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSCI 385 Materials Science Junior Seminar II (0.5 crs)
Prerequisite: MSCI 384
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

Materials Science (MSCI)

MSCI 291 Special Topics in Materials Science (1-3 crs)
Prerequisite: CHEM 104 or CHEM 109 or CHEM 115; PHYS 232; MSE 221
Consent: Instructor Consent Required
- Field trips optional. A total of no more than nine credits from MSCI 291 and MSCI 491 may be applied toward major or graduation.

MSCI 384 Materials Science Junior Seminar I (0.5 crs)
Prerequisite: Minimum junior standing
Career preparation for Materials Science majors. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSCI 385 Materials Science Junior Seminar II (0.5 crs)
Prerequisite: MSCI 384
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5
### MSCI 395 Directed Studies (1-3 crs)
Prerequisite: Minimum 2.0 GPA in Materials Science or Materials Science & Engineering comprehensive majors
Consent: Department Consent Required
This course is designed to allow a single student or a group of students to pursue their educational goals and interests under the direction of a faculty member.

Repeat: Course may be repeated
Grading Basis: A-F Grades Only

### MSCI 399 Independent Study - Juniors (1-3 crs)
Prerequisite: Minimum junior standing.
Consent: Department Consent Required
This course provides junior-level students with research opportunities in Materials Science or Materials Science & Engineering.

Repeat: Course may be repeated
Grading Basis: A-F Grades Only

### MSCI 484 Materials Science Capstone I (1 cr)
Prerequisite: MSCI 350; Credit may not be earned in both MSCI 480 and MSCI 484
First of a two-course capstone sequence. This course emphasizes hands-on, project-based experiences that are formulated and executed by the student.

Lab/Studio Hours: 0
Seminar Hours: 2

### MSCI 485 Materials Science Capstone II (2 crs)
Prerequisite: MSCI 484; Credit may not be earned in both MSCI 485 and MSCI 481
Second of a two-semester capstone sequence. This course emphasizes writing projects based on student designed experiments.

Attributes: LE-I1 Integration
Lab/Studio Hours: 0
Seminar Hours: 4

### MSCI 491 Special Topics in Advanced Materials Science (1-3 crs)
Prerequisite: MSCI 300. Limited to Materials Science or Materials Science & Engineering majors.
Consent: Instructor Consent Required
- Field trips optional. A total of no more than nine credits from MSCI 291 and MSCI 491 may be applied toward major or graduation.

Lecture and possibly laboratory or field work in the study of current topics of Materials Science of special interest to advanced students and faculty.

Repeat: Course may be repeated for a maximum of 9 credits

### MSCI 499 Independent Study - Seniors (1-3 crs)
Prerequisite: Minimum senior standing.
Consent: Department Consent Required
This course provides senior-level students with research opportunities in Materials Science or Materials Science & Engineering.

Repeat: Course may be repeated
Grading Basis: A-F Grades Only

### Materials Science and Engineering (MSE)

#### MSE 120 Introduction to Engineering (2 crs)
Prerequisite: MATH 109 or concurrent enrollment.
A comprehensive study of the engineering design process. Discussion of engineering disciplines with comparisons. The laboratory portion of the course includes design projects from various engineering disciplines.

Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 1
Lab/Studio Hours: 3

#### MSE 221 Living in a Materials World (3 crs)
Prerequisite: MATH 114 or concurrent enrollment. No credit if taken after MSCI 100.
Processing and structure's impact on materials properties and performance. Societal benefits of sustainable, biomimetic, or responsible materials selection.

Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

#### MSE 256 Introduction to Computer Aided Design (1 cr)
Prerequisite: MATH 109 or concurrent enrollment.
The course provides an introduction to 3-dimensional computer aided design and modeling.

Lecture/Discussion Hours: 0
Lab/Studio Hours: 3

#### MSE 315 Materials Characterization (4 crs)
Prerequisite: CHEM 103 or CHEM 115 and PHYS 211 or PHYS 231.
A survey of commonly used materials characterization methods (XPS, SEM, AFM, XRD, XRF), including their theory of operation and hands-on experience. Includes a discussion of the measurement process and instrumental analysis of samples.

 Attributes: LE-S3 Creativity
Lecture/Discussion Hours: 2
Lab/Studio Hours: 4

#### MSE 334 Soft Materials (4 crs)
Prerequisite: CHEM 325
Includes in-depth soft materials topics such as synthesis and processing, structure-property relationships, and applications of soft materials.

Lecture/Discussion Hours: 4
Lab/Studio Hours: 0
MSE 350 Thermodynamics of Materials (4 crs)
Prerequisite: MSCI 100 or MSE 221 or GEOL 312; CHEM 104 or CHEM 109 or CHEM 115; MATH 215; PHYS 232 or concurrent enrollment.
Survey of the laws of thermodynamics and their application in Materials Science including phase equilibria. Aspects of quantum mechanics as they relate to Materials Science will be discussed.
Grading Basis: No S/U Grade Option
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

MSE 357 Phase Transformation & Kinetics (3 crs)
Prerequisite: MSE 221; MATH 215; CHEM 104 or CHEM 109 or CHEM 115
Phase transformations are explored with emphasis on microstructure development, the impact of diffusion, and nucleation/growth mechanisms.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 362 Microelectronic Materials Processing (2 crs)
Prerequisite: MSE 350; MSE 357 or concurrent enrollment. No credit if taken after MSCI 362.
Formerly MSCI 362.
The fabrication of microelectronic devices is discussed, and the thermodynamics and kinetics that impact process design. Methods and practices are reviewed.
Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 2
Lab/Studio Hours: 0

MSE 363 Microelectronic Materials Processing Lab (2 crs)
Prerequisite: MSE 350 or CHEM 433 or PHYS 332. No credit if taken after MSCI 363.
Formerly MSCI 363.
The fabrication of microelectronic devices is explored. Methods and practices for photolithography, etching, and deposition are studied in a lab setting.
Grading Basis: A-F Grades Only
Lecture/Discussion Hours: 0
Lab/Studio Hours: 4

MSE 367 Macroprocessing of Materials (3 crs)
Prerequisite: MSE 357
Processing approaches for major categories of bulk materials. Topics range from raw materials to forming and finishing of final products.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 368 Macroprocessing Materials Lab (2 crs)
Prerequisite: MSE 367 or concurrent enrollment.
Practical and analytical aspects of processing techniques and investigation of structure-property-processing relationships using hands-on experiences.
Lecture/Discussion Hours: 0
Lab/Studio Hours: 6

MSE 372 Transport Phenomena (3 crs)
Prerequisite: MATH 312
Principles of momentum, heat, and mass transport. Applications of appropriate differential equations and boundary conditions to solve problems in materials processing.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0

MSE 374 Electrical, Optical and Magnetic Properties of Materials (4 crs)
Prerequisite: PHYS 332 or MSE 350
Credit may not be earned in both MSE 374 and PHYS 374.
A description of the behaviors of crystalline solids. Topics include crystallography, diffraction, and the electrical, optical and magnetic properties of materials. Semiconducting materials and devices will also be discussed.
Lecture/Discussion Hours: 4
Lab/Studio Hours: 0

MSE 386 MS&E Junior Seminar I (0.5 crs)
Prerequisite: Limited to Pre-Materials Science and Engineering or Materials Science and Engineering majors
Must be admitted to MSE by first day of class.
Career preparation for Materials Science & Engineering majors. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSE 387 MS&E Junior Seminar II (0.5 crs)
Prerequisite: MSE 386; Limited to Materials Science and Engineering majors
The second course in the junior seminar course sequence. Will include seminars with external speakers and class discussions of relevant issues.
Lab/Studio Hours: 0
Seminar Hours: .5

MSE 451 Computational Materials Science (4 crs)
Prerequisite: MSE 350 or PHYS 333 or CHEM 434.
Theory and application of computational methods to model, understand and predict the behavior of materials. Labs provide hands-on experience in solving real materials problems using computational approaches.
Lecture/Discussion Hours: 2
Lab/Studio Hours: 4

MSE 475 Nanomaterials (3 crs)
Prerequisite: CHEM 104 or 109 or 115, and one of the following: MSE 350, or PHYS 333, or CHEM 434.
Quantum behavior and statistical mechanics of nanomaterials, plus modern synthesis methods, electronic and optical applications, biomaterials.
Lecture/Discussion Hours: 3
Lab/Studio Hours: 0
MSE 486 MS&E Capstone I (2 crs)
Prerequisite: MSE 256; MSE 350; MSE 387 or departmental consent
First of a two-course capstone sequence. Hands-on, project-based experiences including engineering design, problem solving and Computer Aided Design (CAD).

Lab/Studio Hours: 0
Seminar Hours: 4

MSE 487 MS&E Capstone II (2 crs)
Prerequisite: MSE 486
Second of a two-course capstone sequence. Conclusion of student-designed projects accompanied by preparation of multiple technical documents.

Attributes: LE-I Integration
Lab/Studio Hours: 0
Seminar Hours: 4

MSE 493 Collaborative Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
This course provides students an opportunity to participate in collaborative projects that are performed on campus under the supervision of a faculty member.

Attributes: Internship
Grading Basis: A-F Grades Only

MSE 494 Off-campus Materials Science Internship (1-3 crs)
Prerequisite: 2.50 total GPA; minimum junior standing
Consent: Instructor Consent Required
Off-campus internship with a regional company or other partner, including professional development training and reflection.

Attributes: Internship
Grading Basis: A-F Grades Only