

Course and Subject Guide

The “Course and Subject Guide,” found in the Courses of Instruction section of this book, serves as a table of contents and provides quick access to subject areas and prefixes.

Department of Materials Science and Engineering

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The Department of Materials Science and Engineering addresses the educational and technological challenges of creating, applying and characterizing new materials for manufacturing products for the 21st century. The department is committed to training students at the graduate level in all aspects of modern materials including metals, ceramics, polymers, electronic and optical materials, and materials characterization. Students have opportunities for hands-on research with modern equipment and facilities. The department has strong collaborative programs with other universities in the Dallas–Fort Worth region and with corporations throughout the world. Students have many opportunities to develop highly marketable skills for high-technology companies in electronics, chemical, electric power, automotive, aviation, biomedical and environmental industries, as well as academia.

Financial Support

Teaching assistantships funded by the department and research assistantships funded by individual faculty research grants support the majority of students. Out-of-state and international students who are funded at least half-time are eligible for in-state tuition rates. Contact the chair of the Department of Materials Science and Engineering regarding

assistantships. Contact Student Financial Aid and Scholarships for student loan information.

Research

The **Electron Microscopy Laboratory** houses the new FEI TF20ST analytical high-resolution transmission electron microscope and the FEI Nova 200 Nanolab dual-beam scanning electron microscope/focused ion beam instrument. Recent acquisitions include a 3-D local electrode atom probe tomography system, an environmental scanning electron microscope and a high resolution X-ray diffraction system, an atomic force microscope, and a UV-VIS ellipsometer. Full optical microscopy, sample preparation, and electron microscopy computer simulation facilities are available. The multi-disciplinary, multi-user laboratory emphasizes the production and characterization of nanoscale materials and devices and the transfer of technology to industry.

The **Laboratory of Advanced Polymers and Optimized Materials (LAPOM)** focuses on the development of materials with improved mechanical, tribological and thermo-physical properties, including thermoplastics, thermosets, composites, nanohybrids and coatings. High strength, wide service temperature range, low thermal expansivity, low static and dynamic surface friction, high adhesion of coatings to ceramic and metal substrates, high scratch, wear and mar resistance.

The analytical characterization facilities include a new 200kV Tecnai G20 analytical high-resolution transmission electron microscope with EDS, PEELS, energy filter and HAADF; a new dual beam Nova 200 focused ionbeam/field emission SEM; a Phillips 420 TEM with EDS; a JEOL 5800 scanning electron microscope (SEM) with EDS; a JEOL T-300 SEM; and a Scintag e-ray diffractometer.

The **Polymer Mechanical and Rheological Laboratory** is engaged in investigations of interrelationships between morphology and mechanical properties through the influences of time and temperature of polymers, composites and hybrid organic-inorganic nanocomposites. A Mechanical Testing System (MTS810) equipped with an environmental chamber (-150° to 600° C), video and thermal wave imaging provide stress pattern-temperature relationships around propagating cracks and estimate residual stresses. A Torsional Rheometer provides visuelastic and rheological property evaluation. Reliability of dielectric property retention is being examined through simultaneous effects of radiation and electrical fields using thermally stimulated depolarization currents and thermoluminescence.

The **Materials Synthesis and Processing Laboratory** has research interests focused on the development of aerogels and other novel ceramics for dielectric, sensor and high temperature applications. A complete

synthesis laboratory is available with several spin coaters for thin film development and with a BET surface area/pore size analyzer for structural characterization as well as high temperature furnaces and a critical point dryer.

The **Display Materials Laboratory** works on field emission displays based on field emission and cathodoluminescence. Display performance is currently restricted by several materials-related limitations. We are investigating these materials-related issues, including low work function materials, thin-film getters and novel spacer materials. We are also studying the reliability of organic light emitting materials and low permeability plastic substrates for flexible displays.

The **Laboratory for Electronic Materials and Devices** is a cross-disciplinary laboratory performing basic and applied research on novel materials for advanced electronic devices of all kinds. The laboratory includes a Group IV molecular beam epitaxy system, a 3 MV ion beam accelerator, a comprehensive surface science system and several scanning probe microscopes. The primary areas of research include advanced dielectric materials, high electric field chemical reactions and molecular electronic devices.

The **Advanced Materials Laboratory** has research focused on the structure-property-processing relationships in metallic structural materials. Current investigations are in the areas of bulk metallic glasses; nanocrystalline materials; development of better aluminum, titanium and nickel alloys for structure applications; and shape memory alloys. Emphasis is on advanced processing and characterization.

The **Energy Materials Laboratory** is focused on developing new materials for advanced energy needs. Of particular interest are processing of nanoscale fuel cells, low-K dielectrics, optoelectronics using precursors, sol-gel and colloidal processing with an emphasis on advanced characterization techniques.

Additional Research Support

Federal support of research projects in the department includes funding from the Defense Advanced Research Projects Agency, the National Science Foundation, the Naval Research Labs, the Army Research Laboratory, U.S. Air Force Office of Scientific Research, U.S. Army Soldier Systems Center and the Department of Education. Other research support has been granted by the Texas Advanced Research Program, the Texas Advanced Technology Program, the Texas Energy Research in Applications Program, Texas Instruments, the Baylor College of Dentistry, Texas Utilities Electric, Bell Helicopter- Textron, Ford Motor Co., Eastman Kodak, General Motors, Sematech, Semiconductor Research Corporation, LTV Corporation, Viratech Thin Films and many small high-technology companies in the Dallas-Fort Worth region. Current funding sources include Carbon

Nanotechnologies Inc., NASA, Army Soldier systems, The Naval Research Laboratory, the Army Research Office, Zyvex, Semiconductor Research Corporation, the Texas Advanced Research Program and the Texas Advanced Technology Program.

Admission Requirements

The student must apply for and be granted admission through the office of the dean of the Toulouse School of Graduate Studies; admission requirements applicable to all departments are found in the Admission section of this bulletin or at www.gradschool.unt.edu. Students may also contact the program for current admission requirements.

Admission to the graduate degree programs in materials science is competitive, as available facilities do not permit admission of all qualified applicants. Departmental forms for applying for financial aid may be obtained from the chair of the Department of Materials Science and Engineering or from the web site (www.mtsc.unt.edu/howtoapply.htm). Students currently enrolled in MS degrees (non materials science) at UNT need to reapply for admission to the department of materials science through the graduate school in order to concurrently avail of the dual degree option (see dual degrees in the Admission section of this bulletin). Candidates applying for a dual degree need not resubmit original documents. Application does not imply admission.

Applying is a two-part process. First, prospective applicants for graduate degree programs must obtain and file an application for admission to the UNT graduate school from the graduate dean's office. Second, applicants for graduate materials science degrees must send in a complete copy of the graduate school application, GRE scores, TOEFL scores (if required), original college transcripts, a curriculum vitae, statement of research interests and at least two recommendation letters. If original GRE and TOEFL scores have been sent to the graduate school, a copy of scores can be sent to the department. If financial assistance in the form of a research or teaching assistantship is being sought, this should be requested in a cover letter to the department or by filling out the online request form at www.mtsc.unt.edu/howtoapply.htm.

Admission to the MS (problems-in-lieu-of thesis), MS (thesis) and PhD programs are based on a cumulative assessment of GRE, letters of recommendation and college transcripts. For admission, students must present acceptable scores on the Graduate Record Examination (GRE). Contact the department or the Toulouse School of Graduate Studies concerning standardized admission test requirements. International applicants must also provide a minimum of 550 (paper) or 216 (computer based) on the TOEFL (Test of English as a Foreign Language) exam. Complete college transcripts and two letters of recommendation are required. Further details may be obtained from the departmental office.

Degree Programs

The Department of Materials Science and Engineering offers graduate programs leading to the following degrees:

- Master of Science with a major in materials science and engineering, and
- Doctor of Philosophy with a major in materials science and engineering.

Master's Degree Options

The applicant seeking a master's degree with a major in materials science and engineering will plan a degree program with the assistance of the student's major professor and the advisory committee. A graduate major must present credit for at least 32 semester credit hours. The student must maintain a B average in all formal materials science courses.

Option 1, Master of Science, Thesis

The graduate credit requirement for the Master of Science degree is 32 semester hours chosen in the following manner.

1. Six of the following seven materials science core courses (18 semester credit hours): MTSC 5000, 5100, 5200, 5300, 5400, 5500, 5600.
2. Six semester credit hours may be chosen from materials science or related fields, as approved by the major professor and the advisory committee.
3. Six semester credit hours of MTSC 5950 (Thesis). Work for the master's thesis is comprised of independent and original studies that may be experimental, computational, theoretical or a combination of these. As part of these requirements, the student must present a formal written report that must be approved by the major professor and the advisory committee and filed in the graduate dean's office. Reports for MTSC 5950 must be submitted in a form prescribed by one of the common refereed materials science journals, such as the manuscript form of the American Institute of Physics (see AIP style manual, current edition). See also the graduate school thesis requirements at www.gradschool.unt.edu.
4. Seminar in Materials Science and Engineering, MTSC 5700. A minimum of 2 semester credit hours. Please see "Seminar in Current Topics in Materials Science".

Option 2, Master of Science, Problems in Lieu of Thesis

The graduate credit requirement for the Master of Science degree is 35 semester hours chosen in the following manner.

1. Six of the following seven materials science core courses (18 semester credit hours): MTSC 5000, 5100, 5200, 5300, 5400, 5500, 5600.

2. Nine hours may be chosen from materials science or related fields, as approved by the major professor and the advisory committee.

3. Six semester credit hours of MTSC 5920 and 5930 (Problems in Lieu of Thesis). Research problems in lieu of thesis are independent, original studies that may be experimental, computational, theoretical or a combination of these. As part of the requirements for each problems course, the student must present a formal written report of the work done in the course, which must be approved by the major professor and the advisory committee and filed in the graduate dean's office. Reports for MTSC 5920-5930 must be submitted in a form prescribed by one of the common refereed materials science journals, for example, in the manuscript form prescribed by the American Institute of Physics (see AIP style manual, current edition). See also the graduate school problem-in-lieu-of-thesis requirements at www.gradschool.unt.edu.

4. Seminar in Materials Science and Engineering, MTSC 5700. A minimum of 2 semester credit hours.

Seminar in Current Topics in Materials Science

All MS (thesis) and PhD students are expected to attend MTSC 5700 during each term/semester of full-time graduate study. Candidates for a Master of Science (thesis) degree must present their work during the regularly scheduled departmental seminar prior to the oral examination before the graduate committee. Candidates for the Master of Science (problems in lieu of thesis) must give a seminar based on the reports written for MTSC 5920-5930 and obtain a minimum grade of B for the seminar. The thesis/problem adviser must be present for the seminar presentation.

Examinations

An entrance interview and proficiency examination concerning fundamental materials science is required of all students. The results are used for advisory, placement and remedial purposes.

An oral presentation of the master's thesis is required. A decision on acceptance of the thesis will be made by the student's advisory committee after an oral examination is successfully completed. A decision on the acceptance of a written report based on problems in lieu of thesis will be made by the student's advisory committee. Guidelines for thesis preparation are available from the department secretary. See also the graduate school requirements at www.gradschool.unt.edu.

Doctor of Philosophy

The Doctor of Philosophy degree represents the attainment of a high level of scholarship and achievement in independent research that culminates in the completion of a dissertation of original scientific

merit. Hence, it cannot be prescribed in terms of a fixed semester credit hour requirement.

Course work and research amounting to the equivalent of two academic years beyond the master's degree or three years beyond the bachelor's degree may be considered the minimum.

Generally, the degree consists of 60 semester credit hours beyond the master's degree, with 12 semester credit hours allocated for the dissertation.

It is expected that the candidate will have published at least one original research article in a refereed journal prior to graduation.

Admission to the Doctoral Program

Departmental admission to the doctoral program in materials science (as distinguished from admission to candidacy for the PhD program) requires a satisfactory score on the written and oral sections of the qualifying examination. This is normally taken after completion of the basic curriculum, after the second year. Enrollment in MTSC 6950 will not be allowed until the student has completed this requirement. Contact the Toulouse School of Graduate Studies or the program for current admission requirements, or see information posted on the graduate school web site at www.gradschool.unt.edu.

Examinations

An entrance interview and proficiency examination are required of all graduate students in materials science, as described above under the master's examinations. The following examinations apply to the Doctor of Philosophy degree.

Qualifying Examination

1. A written qualifying examination is taken after completion of the core curriculum courses over the contents of these courses. The departmental examination committee will schedule and administer the exam, usually in the summer term/semester.
2. Students have a total of two attempts to pass the written qualifying examination.
3. Students who pass the written qualifier are scheduled for the oral examination, which is to be conducted within one month of passing the written examination. The oral examination consists of a proposal by the student on how he/she would perform PhD research on a topic unrelated to their current field of research designated by the evaluation subcommittee. Students have a maximum of two attempts at the oral examination.
4. Upon passing the written and oral examination by the examination committee and major adviser, the applicant applies to the dean of the Toulouse School of Graduate Studies for admission to candidacy and may begin research.

Final Examination

This oral examination is primarily a defense of the dissertation, which must be submitted in final form to the final examination committee at least seven days prior to the scheduled oral examination. At least one final examination committee member must be from a department other than the Department of Materials Science and Engineering. Guidelines for dissertation preparation are available from the department secretary.

Course Work

For the student who has not had previous graduate study, the approximate requirements follow.

1. Seven materials science core courses: MTSC 5000, 5100, 5200, 5300, 5400, 5500 and 5600.
2. Sixty hours may be chosen from materials science or related fields, as approved by the student's major professor and the advisory committee. Individual research hours (MTSC 6940) should not exceed 30 hours.
3. Twelve semester credit hours of MTSC 6950 (Doctoral Dissertation).
4. Seminar in Materials Science and Engineering, MTSC 5700. A minimum of 2 semester credit hours. Please see "Seminar in Current Topics in Materials Science."

Seminar in Current Topics in Materials Science and Engineering

All doctoral students are expected to attend MTSC 5700 during each term/semester of full-time graduate study. A seminar based on the student's dissertation research must be given during the regularly scheduled class time prior to and in addition to the formal defense of the dissertation.

Minor in Materials Science and Engineering

Students pursuing degrees in other disciplines can apply for a minor in materials science through the department office. The minor of materials science requires 12 hours of materials science related course work approved by the department graduate adviser.

Courses of Instruction

All courses of instruction are located in one section at the back of this catalog.

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