Materials Science (Ph.D.)

*UAB, the University of Alabama (Tuscaloosa), and the University of Alabama in Huntsville offer a joint, interdisciplinary program leading to the Ph.D. degree in materials science.

Degree Offered:	Ph.D.*
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UAB Faculty

J. Barry Andrews, Professor (Materials Science and Engineering); Polymer and Metal Matrix Composites, Solidification, Physical Metallurgy, Electronic Properties

Renato Camata, Associate Professor (Physics), Pulsed Laser Deposition, Nanostructured Materials, Biomaterials

Aaron Shane Catledge, Research Assistant Professor (Physics), Hard Carbon Films, Nanostructured Diamond, Homoepitaxial Diamond Growth, Transport Measurements

Krishan K. Chawla, Professor (Materials Science and Engineering); Metal-, Ceramic-, and Polymer-Matrix Composite Materials; Fibers, Interfacial Phenomena

Derrick R. Dean, Associate Professor (Materials Science and Engineering); Structure-Property Relationships of Polymers and Multiphase Polymer Systems

Lawrence J. DeLucas, Professor (Optometry); Microgravity Processing of Protein Crystals

Alan Eberhardt, Associate Professor (Biomedical Engineering); Solid Mechanics, Analytical and Numerical Methods, Biomechanics

Dale S. Feldman, Associate Professor (Biomedical Engineering); Porous Polymeric Soft-Tissue Implant Biocompatibility, Biodegradable Composites, Biomechanics

Gary M. Gray, Professor (Chemistry); Synthesis, Characterization and Applications of Inorganic Polymers

Robin D. Foley, Associate Professor (Materials Science and Engineering); Materials Characterization, Physical Metallurgy, Metals Casting

Tracy P. Hamilton, Associate Professor (Chemistry); Chemistry of Small Atom Clusters and Interactions

Joseph G. Harrison, Associate Professor (Physics); Energy-Band Structure, Electronic Structure of Defect Systems, Molecular Metals

Gregg M. Janowski, Associate Professor (Materials Science and Engineering); Electron Microscopy, Composite Materials, Physical Metallurgy, Structure-Processing-Property Relationships

Chris Lawson, Professor (Physics); Nonlinear Optics, Fiber Optics, Optical Fibers

Jack E. Lemons, Professor (Dentistry); Design of Ligament and Tendon Prostheses, Development of Synthetic Bone Products

Burton R. Patterson, Professor (Materials Science and Engineering); Powder Processing, Physical Metallurgy, Composite Materials, Quantitative Microscopy

Rosalia N. Scripa, Professor (Materials Science and Engineering); Ceramics and Glass, Extractive Metallurgy, Semiconductor of Crystal Growth, Electronic-Magnetic Materials

David L. Shealy, Professor (Physics); X-ray Telescopes, Microscopes and Lithography, Optics, Free Electron Lasers

Andrei Stanishevsky, Assistant Professor, (Physics), Processing, Characterization and Applications of Thin Films and Structures

Yogesh K. Vohra, Professor (Physics); Thin Diamond Films, Laser and X-ray Characterization of Materials at Extreme Conditions

Mary Ellen Zvanut, Professor (Physics); Electrical Studies and EPR Studies of Insulators and Semiconductors

Participating Faculty from the University of Alabama (Tuscaloosa)

Viola Acoff, Professor (Metallurgical and Materials Engineering); Physical Metallurgy, High Temperature Materials, Electron Microscopy, Welding

Martin G. Bakker, Associate Professor (Chemistry); Physical Chemistry; Electron Paramagnetic Resonance, Surfactants

Mark E. Barkey, Professor (Aerospace Engineering and Mechanics); Structural Durability and Fatigue Performance;

Richard C. Bradt, Professor (Metallurgical and Materials Engineering); Ceramic Materials

Michael P. Cava, Ramsay Professor Emeritus (Chemistry); Organic Conductors, Synthetic Methods

Peter Clark, Associate Professor (Chemical and Biological Engineering); Fluid Rheology, Flow of Fluid Complex Mixtures-Slurries, Emulsions, and Gels

William D. Doyle, Professor (Physics); Magnetic Materials and Devices for Information Storage

Nagy H. El-Kaddah, Professor (Metallurgical and Materials Engineering); Materials Process Modeling

James W. Harrell, Jr., Professor (Physics); Nuclear Magnetic Resonance of Molecular Motions in Solids

Stanley E. Jones, Professor (Aerospace & Mechanics); Plasticity Analysis, Nonlinear Mechanics, and Applied Mathematics

Lowell D. Kispert, Research Professor (Chemistry); Structure of Free Radicals in Single Crystals, Magnetic Resonance Methods, Conducting Polymers, Solid-State Photochemistry

Gary Mankey, Professor (Physics); Nanostructure Ferromagnets

Robert M. Metzger, Professor (Chemistry); Solid-state Chemistry, Organic Conductors, X-ray Crystallography, Solid-State Theory

David Nikles, Professor (Chemistry); Chemistry, Application of Materials for Optics and Information Technology, Optical Data Storage, Flexible Magnetic Media

Ramana Reddy, ACIPCO Professor (Metallurgical and Materials Engineering); High-Temperature Materials Processing, Thermodynamics

Sanjoy K. Sarker, Associate Professor (Physics); Statistical Mechanics and High-Field Effects in Semiconductors

Shane C. Street, Associate Professor (Chemistry); Analytical Chemistry; Ultrathin Oxide Films; Tribology

Pieter B. Visscher, Professor (Physics); Metals Physics, Viscoelastic Properties of Materials

Garry W. Warren, Professor (Metallurgical and Materials Engineering); Corrosion and Surface Electrochemistry

Mark Weaver, Professor (Metallurgical and Materials Engineering); Microstructure-Property Relations; Intermetallic Compounds; Structural Materials; Thin Films; Materials Characterization

Participating Faculty from the University of Alabama in Huntsville

James K. Baird, Professor (Chemistry); Theory of Ostwald Ripening, Electron Transport, Radiation Effects

Ramon Luis Cerro, Professor (Chemical and Materials Engineering); Langmuir-Blodgett Ultrathin Films, Capillary Hydrodynamics

Liqing Chen. Associate Research Professor (Chemistry); X-ray Crystallography, Structural Biology, Structural Genomics, Structure-Based Drug Discovery And Development.

Krishnan Chittur, Professor (Chemical and Materials Engineering); Biological Thin Films, Polymer Films

Stephen Edmondson, Associate Research Professor (Chemistry); Thermodynamics, Structure of Proteins and Nucleic Acids

Michael A. George, Associate Professor (Chemistry); Interactions Between Adsorbate Layers and Surfaces of Thin Films

John C. Gregory, Professor (Chemistry); Interaction of Atomic Oxygen and High-Energy Particles with Surfaces and Bulk Materials

William F. Kaukler, Associate Research Professor (Chemistry); Solidification, X-ray microscopy of solidification dynamics

Edward J. Meehan, Jr., Professor (Chemistry); Crystal Growth of Proteins, X-ray Crystallography of Protein Single Crystals

Carmen Scholz, Associate Professor (Chemistry); Green Chemistry, Biodegradable Biomaterials

John Shriver, Professor (Chemistry); Protein Structure and Stability, NMR, Microcalorimetry, Thermophile Protein

William N. Setzer, Professor (Chemistry); NMR and X-ray Conformational Analysis of Novel Organic Compounds

James E. Smith, Professor (Chemical and Materials Engineering); Catalysis, Powder Metals

Bernhard Vogler, Associate Professor (Chemistry); NMR Analysis of Biological Molecules.

Jeffrey Weimer, Associate Professor (Chemistry); Surface Banding Studies

Francis C. Wessling, Professor (Mechanical and Aerospace Engineering); Space Processing of Materials

Admission

Admission into the materials science graduate program through UAB is by recommendation of the UAB Materials Science Program Committee. On acceptance into the program, the student will be affiliated with a "host" department. Assistantships can be awarded either by the host department or by the materials science program. Until a student has chosen a mentor, the Materials Science graduate program director, or his or her designate, will advise the student.

Course Work

Students enter this program with diverse undergraduate training in engineering, physical, or biological sciences. The multidisciplinary curriculum has been structured to develop a common philosophy of the interrelationship of structure, properties, and synthesis of

materials. The program committee can waive some course work for a student entering the program with a master's degree in an appropriate discipline.

During the first phase of instruction (usually 12 semester hours), the student is expected to acquire a core of knowledge in materials science through formal course work and independent study. The core is divided into four topical areas: (1) structure and analysis; (2) condensed matter science; (3) thermodynamics and kinetics; and (4) structure, processing, and properties. Each student's background will be evaluated in order to develop an individual program of study, which may involve some undergraduate course work to satisfy prerequisites for graduate courses and to provide sufficient breadth of coverage of the core areas. To complete this phase, the student must pass Program Examination I which is offered twice per year. The student is expected to choose a mentor before completion of Program Examination I.

The second (specialization, normally 24 semester hours) and the third (electives, 12 semester hours) phases of the curriculum are planned by the student and the research adviser, with approval of the student's graduate study committee. Available areas of specialization are (1) structure and properties of materials; (2) macromolecular materials; (3) electronic, optical, and magnetic materials; (4) materials processing; (5) biomaterials or (6) mechanical behavior of materials.

Courses may be taken at UAB, the University of Alabama (Tuscaloosa), or the University of Alabama in Huntsville. Near the end of the formal course work, the student must pass a comprehensive examination (Program Examination II) set by the student's graduate committee and present a dissertation proposal.

Foreign Language Requirement

Each student is required to demonstrate reading proficiency in a foreign language or proficiency in a technique or skill that is a useful adjunct to the research degree. In the case of a foreign language, competency will be established by an examination that consists of the student translating (with dictionary) a research article, chosen by the student's graduate study committee. A pass/fail determination will be made by the student's graduate study committee after receiving an assessment of merit from a foreign language professor. The language chosen may not be the native tongue of the student and must be from the following list: Chinese, French, German, Japanese, or Russian. A particular research technique or skill must be approved by the student's graduate study committee.

Program Completion

Since the Ph.D. is a research degree, all students are expected to acquire most of their advanced knowledge through research training. These activities will be directly supervised by the student's mentor. The student will write a dissertation and defend it by oral examination.

NIBIB Supported T-32 Predoctoral Training Grant

National Institute of Biomedical Imaging and Bioengineering (NIBIB) has awarded an interdisciplinary predoctoral training grant to UAB that is entitled “Nanotechnology in Biosensors and Bioengineering”. It is a five year program that started on September 1, 2007.

Benefits to participating graduate students include: graduate stipends of $25,000 per year, full tuition and health insurance, and a travel award of $1,000 per year. The purpose of this grant is to implement a training program at the interfaces of physics, chemistry, materials science and engineering, and biomedical engineering that will reduce the time from discovery of a new tool in nanotechnology to its application in medical devices, tissue engineering, and biosensors for earliest detection of molecular signatures of disease.

For more information regarding this training program, visit **http://www.uab.edu/cnmb/graduate/index.html**.

Additional Information

Deadline for Entry Term(s):	Each semester and summer
Deadline for All Application Materials to be in the Graduate School Office:	Six weeks before term begins
Number of Evaluation Forms Required:	Three
Entrance Tests	GRE (TOEFL and TWE also required for international applicants whose native language is not English.)
Comments	None
Graduate Catalog Description	**http://main.uab.edu/show.asp?durki=24907**

For detailed information, contact Dr. Gregg M. Janowski, Graduate Program Director, The University of Alabama at Birmingham, Department of Materials Science and Engineering, BEC 254, 1530 3rd Avenue South, Birmingham, AL 35294-4461.

Telephone: 205-934-8450,

E-mail: **janowski@uab.edu**

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Course Descriptions

UAB Courses

For courses at cooperating universities, see the graduate catalogs of the University of Alabama (Tuscaloosa) and the University of Alabama in Huntsville. Unless otherwise noted, all courses are for 3 semester hours of credit.

Courses at UAB have the following prefixes:

Biomaterials CD	(Clinical Dentistry)
Biomedical Engineering	BME
Chemistry	CH
Materials Science and Engineering	MSE
Physics	PH

A partial list of courses that prepare students for Program Examination I (See program director for reading list) is as follows:

Structure and Analysis

BME 716	Instrumental Methods of Analyses.
CH 580	Polymer Chemistry for Graduate Study I.
CH 730	Physical Organic Chemistry I.
CH 740	Bonding and Structure in Inorganic Compounds.
MSE 565	Characterization of Materials. 4 hours.
MSE 743	Materials Characterization I.
MSE 744	Materials Characterization II.
PH 745	Molecular Spectroscopy.

Condensed Matter Science

CD 661	Physical Properties of Biomaterials.
CH 725	Molecular Structure and Spectroscopy.
PH 753	Advanced Solid State Physics I.
PH 754	Advanced Solid State Physics II.
PH 771	Quantum Mechanics I.
PH 772	Quantum Mechanics II.

Thermodynamics and Kinetics

CH 729	Special Topics in Physical Chemistry. 1-3 hours.
MSE 703	Thermodynamics of Materials.
PH 635	Statistical Mechanics.

Structure, Processing, and Properties

CH 580	Polymer Chemistry I for Graduate Study.
MSE 280	Engineering Materials.
MSE 281	Physical Materials I.
MSE 381	Physical Materials II.
MSE 570	Ceramic Materials.

A partial list of courses for each specialization is given below. Additional courses may be accepted at the discretion of the graduate committee.

Specialization 1: Structure and Properties of Materials.

Must include 3 hours in instrumentation, 3 hours in methods of chemical analysis, and 3 hours in spectroscopy.

BME 542	Principles of Medical Imaging
BME 546	Principles of MRI
BME 716	Instrumental Methods of Analyses
BME 742	Medical Imaging Instrumentation
CH 729	Special Topics in Physical Chemistry
CH 749	Special Topics in Inorganic Chemistry
CH 750	Advanced Analytical Chemistry
CH 751	Advanced Analytical Chemistry II
CH 755	Electroanalytical Chemistry
CH 757	Analytical Spectroscopy
MSE 703	Thermodynamics of Materials
MSE 718	Surfaces, Interfaces, and Thin Films
MSE 737	Quantitative Microscopy
MSE 743	Materials Characterization I
MSE 744	Materials Characterization II
MSE 753	Phase Diagrams

Specialization 2: Macromolecular Materials.

Must include 3 hours in advanced inorganic or organic chemistry, 3 hours in macromolecular chemistry, and 3 hours in macromolecular physics.

BME 511	Polymers for Biomedical Applications I
BME 520	Tissue Interactions
BME 712	Polymers for Biomedical Applications II
BME 750	Implants in Dentistry
CH 580	Polymer Chemistry I for Graduate Study II
CH 581	Polymer Chemistry II for Graduate Study II
CH 729	Special Topics in Physical Chemistry
CH 739	Special Topics in Organic Chemistry

Specialization 3: Electronic, Optical, and Magnetic Materials.

Must include 3 hours in spectroscopy and 6 hours in the electronic, optical, or magnetic properties of materials.

CH 729	Special Topics in Physical Chemistry
CH 743	Chemical Applications of Group Theory
CH 744	Spectroscopy of Inorganic Chemistry
MSE 584	Electronic, Magnetic and Thermal Properties of Materials
MSE 718	Surfaces, Interfaces, and Thin Films
MSE 743	Materials Characterization I
PH 623	Modern Optics I
PH 655	Advanced Solid State Laboratory
PH 715	Advanced Statistical Mechanics
PH 741	Mossbauer Spectroscopy
PH 742	Electron Spin Resonance
PH 750	Classical Electrodynamics I
PH 751	Classical Electrodynamics II
PH 753	Advanced Solid State Physics I
PH 754	Advanced Solid State Physics II
PH 760	Methods of Mathematical Physics
PH 762	Computational Physics

Specialization 4: Materials Processing.

Must include 6 hours in solidification or crystal growth and 3 hours in processing technology.

CD 633	Alloy Systems in Dentistry
MSE 503	Materials Processing
MSE 713	Mechanical Behavior of Materials
MSE 715	Nucleation and Growth
MSE 716	Microstructural Processes
MSE 718	Surfaces, Interfaces, and Thin Films
MSE 723	Solidification
MSE 753	Phase Diagrams

Specialization 5: Biomaterials.

Must include 6 hours in the structure and properties of biomaterials and 3 hours in biomaterials applications.

BME 511	Polymers for Biomedical Applications I
BME 520	Implant Tissue Interactions
BME 712	Polymers for Biomedical Applications II
BME 750	Implants in Dentistry
BME 753	Ceramic Materials in Dentistry
BME 754	Alloy Systems in Dentistry

BME 790	Special Topics in Biomaterials, 1-6 hours
BME 791	Individual Study in Biomaterials, 1-6 hours
CD 626	Surgical Implants in Dentistry
CD 629	Ceramic Cements, Alloy-Ceramic Systems
CD 633	Alloy Systems in Dentistry
CD 661	Physical Properties of Biomaterials
CD 662	Laboratory Methods for Biomaterials Research

Specialization 6: Mechanical Behavior of Materials.

Must include 3 hours in ceramic, metallurgical, or polymer engineering, 3 hours in the mechanical behavior of materials, and 3 hours in the characterization of materials.

BME 716	Instrumental Methods of Analyses
BME 733	Tissue Mechanics
BME 737	Biomechanics: Tissue Mechanics II
BME 776	Fracture Mechanics
MSE 713	Mechanical Behavior of Materials
MSE 737	Quantitative Microscopy
MSE 743	Materials Characterization I
MSE 744	Materials Characterization II
PH 610	Classical Mechanics I
PH 611	Classical Mechanics II
PH 710	Advanced Classical Mechanics I
PH 711	Advanced Classical Mechanics II

Last modified 06/24/09