Materials and Nanotechnology

Department Information

- **Program Director:**
  Erik K. Hobbie, Ph.D.
- **Email:**
  Erik.Hobbie@ndsu.edu
- **Department Phone:**
  (701) 231-6103
- **Department Web Site:**
  www.ndsu.edu/materials_nanotechnology/ (http://www.ndsu.edu/materials_nanotechnology/)
- **Application Deadline:**
  April 1 for fall semester.
- **Credential Offered:**
  Ph.D.
- **Test Requirement:**
  GRE
- **English Proficiency Requirements:**
  TOEFL iBT 71, IELTS 6; Duolingo 100

North Dakota State University (NDSU) offers an interdisciplinary program leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree in Materials and Nanotechnology (MNT). The program includes a series of required MNT core courses; additional elective courses; written and oral preliminary examinations; a doctoral dissertation based on independent, original research in materials and nanotechnology; and a final oral examination on the dissertation.

**Admission Requirements**

The program in Materials and Nanotechnology is open to qualified graduates of universities and colleges of recognized standing. Applicants with a degree in the disciplines of chemistry, engineering, material science and engineering, physics, polymer science, polymer engineering, or related fields will be considered for admission. Applicants must meet the Graduate College requirements (https://catalog.ndsu.edu/graduate/admission-information/).

**Financial Assistance**

Students are routinely supported through research assistantships. Applicants are considered based on scholarship, potential to undertake advanced study and research, and financial need. All students who submit complete applications by the appropriate deadlines are considered for assistantships.

In addition to the stipend, graduate assistants receive a graduate tuition waiver. Tuition waivers cover base tuition for NDSU graduate credits only. Students are responsible for differential tuition, student fees, and tuition for non-graduate level credits taken or Cooperative Education credits.

By the end of the first academic year, the student will select an academic adviser from among the MNT faculty and arrange for the appointment of a supervisory committee. This committee will consist of at least four members of the graduate faculty. This includes the student’s major adviser, at least one additional MNT faculty member, and a graduate school representative.

The plan of study will be prepared by the student, in consultation with the major adviser and supervisory committee, by the end of the first year in residence. The plan must be approved by the student’s graduate supervisory committee, the MNT Program Director, and the Graduate College dean. Master’s students must complete the plan of study by the end of the second semester of study. Doctoral students should complete the plan of study at the end of the first year of study and at least one month prior to the comprehensive oral examination.

**Master of Science**

Materials and Nanotechnology students are able pursue a master’s degree under either the Plan A - Master’s Thesis or the Plan C - Culminating Experience option. Each option requires a minimum of 30 graduate credits with a cumulative grade point average of 3.0 or better.

The Plan A thesis option represents a more traditional Master of Science degree, with an independent research component in the form of an original thesis that can serve as a foundation for future doctoral work in science or engineering. For the thesis option, of the required minimum 30 graduate credits, at least 16 credits must be from approved graduate courses numbered from 601-689, 691, 700-789, and 791 while the research credits (798) must be not fewer than 6 nor more than 10.
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The Plan C option is appropriate for working professional students or students who are certain that they do not wish to pursue a doctorate in any field of science or engineering. In the context of the MNT program, this option requires a 6-10 credit culminating experience (794) which replaces the research credits (798).

Ph.D.

The doctorate requires a minimum of 90 graduate credits. A minimum of 27 credits of didactic coursework are required; no more than 15 didactic credits may be transferred as part of the Plan of Study. The MNT Ph.D. program requires students to complete a series of 7 core courses totaling 17 semester credits. The student will complete additional elective courses to fulfill the Graduate School requirement of 27 semester credits in academic courses. An overall GPA of 3.0 or better must be maintained.

**Core Curriculum**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MNT 729</td>
<td>Materials Characterization</td>
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<td>MNT 730</td>
<td>Nanotechnology and Nanomaterials</td>
<td>3</td>
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<td>MNT 732</td>
<td>Physical Properties of Materials</td>
<td>3</td>
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<td>MNT 745</td>
<td>Preparing Future Researchers</td>
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<td>MNT 756</td>
<td>Molecular Modeling</td>
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<td>MNT 760</td>
<td>Materials Synthesis Processing</td>
<td>3</td>
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<td>MNT 790</td>
<td>Graduate Seminar</td>
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</table>

Students must complete at least an additional 12 credits of graduate level coursework. The courses should be chosen by the students in consultation and with the approval of the student's supervisory committee.

Suggested courses include the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td><strong>Microelectronics Focus</strong></td>
<td></td>
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</tr>
<tr>
<td>ABEN 682</td>
<td>Instrumentation &amp; Measurements</td>
<td>3</td>
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<tr>
<td>CPM 796</td>
<td>Special Topics</td>
<td>2</td>
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<tr>
<td>CHEM 766</td>
<td>Quantum Chemistry I</td>
<td>4</td>
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<tr>
<td>CHEM 767</td>
<td>Quantum Chemistry II</td>
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<td>ENGR 780</td>
<td>Electromagnetic Theory</td>
<td>3</td>
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<tr>
<td>ECE 751</td>
<td>Electromagnetic Theory and Applications</td>
<td>3</td>
</tr>
<tr>
<td>IME 627</td>
<td>Packaging for Electronics</td>
<td>3</td>
</tr>
<tr>
<td>IME 720</td>
<td>Surface Engineering</td>
<td>3</td>
</tr>
<tr>
<td>IME 635</td>
<td>Plastics and Injection Molding Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>MNT 735</td>
<td>Optoelectronics Materials and Processing</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 771</td>
<td>Quantum Physics I</td>
<td>3</td>
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<tr>
<td><strong>Biomaterials Focus</strong></td>
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<tr>
<td>ABEN 758</td>
<td>Applied Computer Imaging and Sensing for Biosystems</td>
<td>3</td>
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<tr>
<td>BIOC 716</td>
<td>Protein and Enzyme Biochemistry</td>
<td>3</td>
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<td>BIOC 673</td>
<td>Methods of Biochemical Research</td>
<td>3</td>
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<tr>
<td>CE 725</td>
<td>Biomaterials-Materials in Biomedical Engineering</td>
<td>3</td>
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<tr>
<td>CPM 771</td>
<td>Modern Methods of Polymer Characterization</td>
<td>3</td>
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<td>ME 668</td>
<td>Introduction to Biomechanics</td>
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<td>ME 731</td>
<td>Mechanical Behavior of Materials</td>
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<td>ME 743</td>
<td>Biomechanics Of Impact</td>
<td>3</td>
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<td>ECE 685</td>
<td>Biomedical Engineering</td>
<td>3</td>
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<tr>
<td>ECE 687</td>
<td>Cardiovascular Engineering</td>
<td>3</td>
</tr>
<tr>
<td>PSCI 611</td>
<td>Principles of Pharmacokinetics and Pharmacodynamics</td>
<td>3</td>
</tr>
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<td>PSCI 701</td>
<td>Quantative Drug Design</td>
<td>2</td>
</tr>
<tr>
<td><strong>Nanomaterials Focus</strong></td>
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<tr>
<td>CE 641</td>
<td>Finite Element Analysis</td>
<td>3</td>
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<tr>
<td>CE 793</td>
<td>Individual Study/Tutorial</td>
<td>3</td>
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<tr>
<td>CPM 673</td>
<td>Polymer Synthesis</td>
<td>3</td>
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</tbody>
</table>
CHEM 766 Quantum Chemistry I 4
CHEM 767 Quantum Chemistry II 2
CPM 686 Corrosion and Materials 3
CPM 773 Organic Chemistry Of Coatings 3
CPM 782 Physical Chemistry Of Coatings 3
CPM 796 Special Topics 3
IME 720 Surface Engineering 3
ME 682 Fuel Cell Science and Engineering 3
ME 712 Advanced Finite Element Analysis 3
ME 733 Polymer Nanocomposites 3
ME 734 Smart Materials and Structures 3
PHYS 758 Statistical Physics 3
PHYS 781 Solid State Physics 3

General Materials Science and Engineering Focus
ABEN 658 Process Engineering for Food, Biofuels and Bioproducts 3
ABEN 644 Transport Processes 3
ME 673 Engineering with Polymeric Materials 3
CE 641 Finite Element Analysis 3
CE 720 Continuum Mechanics 3
CHEM 732 Advanced Survey of Analytical Chemistry 4
CHEM 736 Mass Spectrometry 2
CPM 673 Polymer Synthesis 3
ME 633 Composite Materials Science and Engineering 3
ME 751 Advanced Thermodynamics 3
PHYS 611 Optics for Scientists & Engineers 3
PHYS 781 Solid State Physics 3

Affiliated Faculty

Achintya N. Bezbaruah, Ph.D.
University of Nebraska-Lincoln, 2002
Research Interests: Environmental sensors, Recalcitrant and micro pollutants, Contaminant fate and transport, Small community water and wastewater treatment, Environmental management

Eugene B. Caldona, Ph.D.
Mississippi State University, 2020
Research Interests: Advanced coatings and materials, Corrosion, Electrochemistry, Surface chemistry, Nanocomposites

Yongki Choi, Ph.D.
City University of New York, 2010
Research Interests: Nano-bio-electronics, Carbon nanotube circuits, Single-molecule electronics, Biomedical applications

Andrew Croll, Ph.D.
McMaster University, Ontario, 2009
Research Interests: Polymers, Diblock copolymers, Thin films, Pattern formation, Mechanics

Alan R. Denton, Ph.D.
Cornell University, 1991
Postdoctoral, University of Guelph, 1991-94; Technical University of Vienna, 1994-95, Research Center Julich, 1996-98
Research Interests: Soft condensed matter theory, Computational physics

Erik K. Hobbie, Ph.D.
University of Minnesota, 1990
Postdoctoral: NRC Fellow, NIST, 1990-1992
Research Interests: Colloidal nanoparticles, Polymers, Complex fluids, Chromatography, Self-assembly, Photoluminescence, Flexible electronics

Syeed M. Iskander, Ph.D.
Virginia Polytechnic Institute and State University, 2019
Postdoctoral, University of Southern California, 2019-2020
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Research Interests: Non-recyclable municipal solid waste management, Food waste management, Plastics pollution, Landfilling, and Landfill leachate management

Long Jiang, Ph.D.
Nanyang Technological University, 2003
Research Interests: Polymer/composite processing, Polymer processing machinery/design, Nanocomposites, Biobased polymers/composites, Functional composites with novel microstructures

Alan R. Kallmeyer, Ph.D.
University of Iowa, 1995
Research Interests: Theoretical, computational, and experimental solid mechanics, Fatigue and fracture of engineering materials, Composite materials

Dinesh Katti, Ph.D.
University of Arizona, 1991
Research Interests: Geotechnical engineering, Constitutive modeling of geologic materials, Expansive soils, Multiscale modeling, Steered molecular dynamics, Computational mechanics, Nanocomposites and biomaterials

Kalpana Katti, Ph.D.
University of Washington, 1996
Research Interests: Advanced composites, Nanomaterials, Biomaterials, Biomimetics, Materials characterization/modeling, Analytical electron microscopy, Bone tissue engineering

Dmitri Kilin, Ph.D.
Chemnitz University of Technology, Chemnitz, Germany, 2000
Research Interests: Photo-induced dynamic processes of charge transfer, Nonradiative charge carrier relaxation, Surfaces/interfaces of metal/semiconductor nanomaterials for photovoltaic/photocatalytic energy conversion

Svetlana Kilina, Ph.D.
University of Washington, 2007

Andrei Kryjevski, Ph.D.
University of Washington, 2004
Research Interests: First-principles theoretical descriptions of the electronic properties of nanomaterials

Ivan T. Lima Jr., Ph.D.
University of Maryland, 2003
Research Interests: Photonics

Sylvio May, Ph.D.
Jena, 1996
Research Interests: Physics of lipid membranes, Biophysics

Keerthi Nawarathna, Ph.D.
University of Houston, 2005
Research Interests: Lab-on-a-chip technologies, Single-cell genomics, Nanobiotechnology, Tissue engineering, Novel imaging techniques for biology, Computation/simulations

Selvakumar Prakash Parthiban, Ph.D.
Nagoya University, 2012
Research Interests: Biomaterials, Regenerative medicine, Tissue-engineered vascular grafts, Microvasculature, Decellularized extracellular matrix, Bioceramics, Cancer and vascular biology

Xiaoning Qi, Ph.D.
North Dakota State University, 2009
Research Interests: Corrosion characterization and prevention, Coating design and formulation, Sustainable coatings, Nanocomposites

Mohiuddin Quadir, Ph.D.
Freie University of Berlin, 2010
Research Interests: High performance delivery technologies, Biosynthetic interfaces for medical coatings, Synthesis of new polymers from bio-based resources

Seth C. Rasmussen, Ph.D.
Clemson University, 1994
Postdoctoral, University of Oregon, 1995-1999
Research Area: Inorganic/organic materials chemistry, Chemical history

**Bakhtiyor Rasulev, Ph.D.**
Uzbek Academy of Science, 2002
Postdoctoral, Drew University, 2002; Jackson State University, 2004-2007

**Jing Shi, Ph.D.**
Purdue University, 2004
Research Interests: Microelectronics packaging, Direct-write material deposition, Laser processing for electronics, RFID applications, Modeling of manufacturing processes, Computer integrated manufacturing

**Mukund P. Sibi, Ph.D.**
City University of New York, 1980
Research Interests: Synthetic organic chemistry, Natural products

**Xiangqing (Annie) Tangpong, Ph.D.**
Carnegie Mellon University, 2006
Research Area: Vibrations, dynamics and friction, friction-vibration interaction, friction damping in rotating structures, damping in nanocomposites and biomaterials

**Chad A. Ulven, Ph.D.**
University of Alabama at Birmingham, 2005
Research Interests: Advanced composites materials, Green materials processing, Nondestructive evaluation, Characterization of advanced materials under extreme conditions

**Jessica Vold, Ph.D.**
North Dakota State University, 2015
Research Interests: Additive manufacturing of materials, Polymer composites, Materials characterization, Entrepreneurship

**Andriy Voronov, Ph.D.**
Lviv Polytechnical Institute, 1994
Postdoctoral, Institute Charles Sadron, CNRS, 1997
Research Interests: Polymer synthesis and characterization

**Alexander J. Wagner, Ph.D.**
University of Oxford, 1997
Research Interests: Computational soft matter, Phase separation, Diffusion, Interface physics

**Danling Wang, Ph.D.**
University of Washington, 2013
Research Interests: Chemiresistive sensors, Semiconducting nanomaterials, Optical spectroscopy, Electronic devices, Microfabrication

**Dean Webster, Ph.D.**
Virginia Polytechnic Institute and State University 1984
Research Interests: Synthesis of high performance polymers, Polymerization reactions, Crosslinking chemistry, Quantitative structure-property relationship

**Xiangfa Wu, Ph.D.**
University of Nebraska-Lincoln, 2003
Beijing Institute of Technology, 1998
Research Interests: Nanofabrication/nanomaterials, Advanced functional composites, Fracture/impact mechanics

**Wenjie Xia, Ph.D.**
Northwestern University, 2016
Research Interests: Multiscale modeling, Mechanics of materials, Polymers and composites, Soft matter, Bioinspired materials, Mechanobiology

**Qifeng Zhang, Ph.D.**
Peking University, 2001
Postdoctoral, University of Washington, 2006-2008
Research Interests: Electronic materials, Nanomaterials: synthesis, characterization and device application, Nanotechnology, Materials/devices/technology for energy conversion and storage, Solar cells, Lithium ion batteries, Photocatalysis