DOCTOR OF PHILOSOPHY IN MATERIALS SCIENCE AND ENGINEERING

Program Coordinator

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Program Description

The Doctor of Philosophy (Ph.D.) in Materials Science and Engineering is a cutting-edge program, employing state-of-the-art analytical materials instrumentation not found anywhere else in the area between Cleveland and Pittsburgh. Incorporating the research activities from the YSU Center of Excellence in Materials Science and Engineering (CEMSE) and the Ohio Hub for Innovation and Opportunity in Advanced Materials Commercialization, this program promotes the synergistic interaction of industrially focused research efforts of faculty, students, and commercial research partners leading to economic development of the region. The Ph.D. is specifically targeted at producing graduates who can find employment as industrial research scientists or engineers.

Application Procedure

Program information may be obtained from the College of Science, Technology, Engineering and Mathematics and from the Ph.D. Program (http://www.ysu.edu/academics/science-technology-engineering-mathematics/materials-science-and-engineering-phd/) webpage. Application information may be obtained from The Office of Graduate Admissions in Coffelt Hall (http://www.ysu.edu/gradcollege/) and from Ph.D. Program admission (http://cms.ysu.edu/college-graduate-studies/domestic-admissions/) webpage. All application materials must be submitted though the online application system. (https://ysu.elluciancrmrecruit.com/admissions/pages/welcome.aspx)

Application Requirements

Students with a B.S. or M.S. in materials science, materials engineering, or related fields (including chemistry, physics, or mechanical, chemical, electrical or civil engineering) can be admitted through the College of Graduate Studies on a competitive basis up to the capacity of the program.

Requirements for admission to the Ph.D. program include the following:

- B.S. or M.S. degree in materials science, materials engineering, or related fields (including chemistry, physics, or mechanical, chemical, electrical or civil engineering);
- Cumulative undergraduate grade-point average of at least 3.0 on a 4.0 scale, or a graduate GPA of 3.3/4.0;
- GRE scores are required. Scores in the following ranges generally reviewed favorably: Verbal = 500-800, Quantitative = 650-800, and Analytical Writing = 4.0-6.0;
- For students whose native language is not English, a TOEFL score of 550 (or comparable score on a similar test)
- Completed application (application link).
- Resume
- Statement of intent
- 3 references

All applications will be reviewed by an admissions committee consisting of the program director and a group of program faculty of sufficient breadth to interpret the credentials of all members of the applicant pool. ***The selection/admission process is competitive; meeting eligibility criteria does not assure admission into the program.*** Applications received as complete by February 1st will have full consideration for fall admissions and graduate assistant opportunities.

Graduate Faculty

Farzad Ahmadi, Ph.D., Assistant Professor
Flexible wearable electronics; liquid additive manufacturing;low-loss magnetic materials; 3D printed sensors; embedded systems.

Snjezana Balaz, Ph.D., Assistant Professor
Structure of surfaces of thin films, semiconductors, and nanoclusters

Vamsi Borra, Ph.D., Assistant Professor
3D electronics; Flexible electronics; Electronic materials; reliability testing; Controlled whisker growth; thin-film fabrication and characterization; and condensed matter physics-related research

Kyosung Choo, Ph.D., Associate Professor
Heat and mass transfer; multiphase flow; phase change phenomena; data center cooling; energy audit of buildings; microchannel heat exchangers; linear friction welding; laser welding; kinetics of human body performance

Pedro Cortes, Ph.D., Associate Professor
Structure-property relationships of polymers; composites and hybrid materials; smart materials and structures; development of chem-bio sensing platforms based on carbon nanotubes

Douglas T. Genna, Ph.D., Associate Professor
Metal-organic frameworks;Synthesis of new materials; Mechanistic investigations of self-assembly; targeted materials for water and blood detoxification

Clovis Linkous, Ph.D., Professor
Ceramic electrolytes, polymer membrane electrolytes, solid state hydrogen storage, photovoltaic materials, photocatalysis; flexible and optically transparent conductors

Holly J. Martin, Ph.D., Associate Professor
Corrosion studies; modification of metal surfaces to strongly adhere polymeric coatings for corrosion resistance

Tom Nelson Oder, Ph.D., Professor
Micro/nano fabrication and characterization of electronic and opto-electronic devices of wide band gap semiconductors: SiC, group III-nitrides, ZnO

Byung-Wook Park, Ph.D., Assistant Professor
Engineered biohybrid materials for biomedical applications;biohybrid microswimmers for drug delivery and bioimaging;wearable bioelectronics for chronic wound monitoring; smart wound dressing

Donald Priour, Ph.D., Associate Professor
Theoretical condensed matter physics, particularly related to systems of technological relevance where the flow of charge or fluid is modified or inhibited by disorder in the form of random inhomogeneities or severed wires or bonds

Jae Joong Ryu, Ph.D., Associate Professor
Effect of process induced anisotropic microstructure on sliding contact fatigue damage of titanium alloy joint implants; mechanical load assisted dissolution response of medical#grade metals and alloys

Virgil C. Solomon, Ph.D., Professor
Synthesis of shape memory alloys, ceramic-metal composites and nanostructures and their characterization using metallography, thermal analysis and analytical scanning and transmission electron microscopy techniques

Timothy R. Wagner, Ph.D., Professor, Chair

Synthesis of inorganic oxide and mixed-anion materials; structure characterizations using single crystal and powder X-ray diffraction; electron microscopy techniques

Degree Requirements

- 90 Semester Hours of Graduate Study
- Qualifying exam, based on the topics presented in the core curriculum, following the second year of study.
- Recommended internship program, usually through full-time paid employment at a partner company.
- Written research proposal, describing the work to be completed for the dissertation. The proposal will be presented orally and defended in front of the dissertation committee.
- Oral presentation of research accomplishments, approximately mid-way through the dissertation research at Seminar.
- Dissertation defended orally to the dissertation committee, which will also approve the final written document. Completion of the dissertation is the culminating experience of the Ph.D. program.

Coursework

COURSE	TITLE	S.H.
Materials Science and Engineering Course Core		
MATL 7010	Analytical Methods for Materials Science 1	3
MATL 7020	Analytical Methods for Materials Science 2	3
MATL 8010	Structure of Materials	3
MATL 8020	Mechanical Properties of Materials	3
MATL 8030	Thermodynamics and Phase Behavior	3
MATL 8040	Kinetics, Diffusion, and Rate Processes	3
MATL 8050	Materials Internship or electives	6
MATL 6990	Seminar in Materials Science and Engineering	3
Materials Science and Engineering Research Core		**51**
MATL 6982 and MATL 8060 combined must equal 51 s.h.		
MATL 6982	Graduate Research	
MATL 8060	Dissertation	
Electives		
Select 12 s.h. of Electives.		12
Total Semester Hours		**90**

Special Notes

College of Graduate Studies policies concerning transfer credits, time limits, and other academic matters must be followed.

https://ysu.elluciancrmrecruit.com/admissions/pages/welcome.aspx

Learning Outcomes

- The student will have developed a fundamental understanding of the structure of matter at the atomic/molecular level, particularly in the solid state, and its influence on the physical and chemical properties of a substance.
- The student will have developed a familiarity with the instrumental tools of materials research, including microscopy, spectroscopy, and mechanical testing.
- The student will have developed the personal organizational and disciplinary skills to grasp a research problem involving a lengthy program of investigation, break it down into a sequence of tasks, and follow them through to a conclusion.
- The student will have developed sufficient writing skills to prepare laboratory reports, research papers, journal articles, and an organized dissertation comprising a hundred pages or more.

Graduate Courses

MATL 6982 Graduate Research 1-6 s.h.
Individual investigation of advanced topics under the guidance of selected program faculty. May be repeated for a maximum of 30 semester hours. ,.

MATL 6990 Seminar in Materials Science and Engineering 1 s.h.
Presentations of ongoing research in materials science and engineering. Includes presentations by guest speakers, faculty and graduate students. May be repeated for a maximum of 3 semester hours.

MATL 7010 Analytical Methods for Materials Science 1 3 s.h.
A laboratory course where the student will receive hands-on training with instruments commonly used in materials research. Techniques covered include electrical response methods, spectroscopic methods, X-ray techniques, and thermal analysis and surface profiling techniques. (2 hour lecture/3 hour lab).

MATL 7020 Analytical Methods for Materials Science 2 3 s.h.
A laboratory course where the student will receive hands-on training with instruments commonly used in materials research. Instruments covered include light microscopes, scanning electron microscopes, transmission electron microscope, focused ion beam, X-ray photoelectron spectrometer, Auger spectrometer, X-ray microscope, and dynamic mechanical analyzer. (2 hour lecture/3 hour lab).

MATL 8010 Structure of Materials 3 s.h.
A study of the structure/property relationship of materials at the electronic, atomic, and molecular level. Using quantum chemistry, symmetry, chemical bonding and electrochemistry, this course will introduce the student to the classification and properties of amorphous, crystalline, and semi-crystalline structures including metals, semiconductors, ceramics, polymers, and hybrid materials. The properties to be studied include mechanical, thermal, electrical, and magnetic properties.

MATL 8020 Mechanical Properties of Materials 3 s.h.
This course addresses the mechanical behavior of materials, assuming knowledge of elasticity, plasticity, fracture and creep, and aims to provide a robust analytical treatment of these topics across size scales and material types. The course is split into three sections: (a) Continuum mechanics, (b) Advanced phenomena in mechanics of materials, and (c) Case studies focused on the design and processing of materials.
Prereq.: MATL 8010.

MATL 8030 Thermodynamics and Phase Behavior 3 s.h.
Detailed examination of chemical equilibria and chemical changes with an emphasis on the theoretical basis for these phenomena and the properties of phase diagrams. The use of computer models for chemical equilibrium calculations utilizing extensive thermodynamic databases.

MATL 8040 Kinetics, Diffusion, and Rate Processes 3 s.h.
Essential topics covered include diffusion in solids and liquids; complex motion of dislocations and interfaces; complex kinetics of phenomena such as phase transformations and morphological evolution; and the rate at which these and other kinetic phenomena occur.
Prereq.: MATL 8030.

MATL 8050 Materials Internship 1-6 s.h.
Supervised experience in approved external industrial, government lab, or other comparable environment, working on advanced problems in materials. For materials science and engineering doctoral students or by permission of program coordinator. May be repeated for a maximum of 6 semester hours.
Prereq.: MATL 8020.

MATL 8060 Dissertation 1-9 s.h.
Design, proposal, completion, and reporting of scholarly research deemed acceptable to the program faculty. Culminates in an oral presentation to dissertation committee.
Prereq.: completion of qualifying exam and research proposal.