

Notice of Intent, PhD in Materials Science and Engineering

University of Wisconsin-Milwaukee

Submission Track: NOI fast-track

ABSTRACT: The University of Wisconsin-Milwaukee (UWM) proposes to establish a Doctor of Philosophy (Ph.D.) program in Materials Science and Engineering. The establishment of this program supports UWM's mission to remain R1 institution and maintain high-quality graduate programs appropriate to a major urban doctoral university. Materials Science and Engineering has been a track within a college-wide Ph.D. in Engineering (established in 1986). Over the years, the track had a consistent enrollment of about 16 students. The current request is to elevate the track to a stand-alone degree that is more descriptive of the program of study. The request for the spin-off is in line with the decisions of other departments, such as Electrical Engineering and Mechanical Engineering, to establish their stand-alone Ph.D. programs in the College. Graduates will benefit from a more recognizable credential, making them more competitive in the job market. The proposed program will be more attractive to prospective students and will enhance graduate placement in positions that require a doctorate in the specific discipline of Materials Science and Engineering. This is a win-win for all stakeholders as a better match is expected to have a net positive effect on student engagement, preparation, and the program's success rate. The proposed curriculum will be the same as the current Materials Science and Engineering track of the college-wide Ph.D. program. The program will be comprised of 66 graduate credits beyond the bachelor's degree and includes an approved minor area and doctoral thesis. No new courses or new faculty/staff will be needed to implement this program. There are no planned changes in research foci – current areas of strength include metal casting, physical metallurgy, alloys, composites, energy storage, membranes, water filtration, and materials characterization, with the potential addition of nano-electronic and advanced optoelectronic materials.

PROGRAM IDENTIFICATION

University Name: University of Wisconsin-Milwaukee

Title of Proposed Academic Degree Program: Materials Science and Engineering

Degree Designations: Doctor of Philosophy

Suggested Classification of Instructional Programs (CIP) Code: 14.1801 - Materials Engineering

Mode of Delivery: Single institution; Face-to-face

Department or Functional Equivalent: Department of Materials Science and Engineering

College, School, or Functional Equivalent: College of Engineering and Applied Science (CEAS)

Proposed Date of Authorization: August 2025

Proposed Date of Implementation: Fall 2025

PROGRAM INFORMATION

Rationale

Materials Science and Engineering (MSE) combines chemical, physical, and engineering principles to the design, synthesis, processing, and applications of diverse types of materials (metals, ceramics, polymers, composites, etc.). It includes metal casting, physical metallurgy, advanced manufacturing, composite-

materials processing, materials for energy storage, materials and membranes for water purification, alloy development, coatings, materials recycling, and materials characterization, among other areas. Materials engineering is one of the fundamental engineering disciplines, and materials engineering careers take diverse forms.

The undergraduate materials science and engineering program at UWM has been present (with some early changes in name) since the inception of the College of Engineering in the 1960s. The undergraduate materials science and engineering program graduates approximately 12 students each year. The department plays a key role in the college's mission to educate students to become creative problem solvers and to act as a catalyst for improved economic development and quality of life in Wisconsin. With the fast-paced changes in materials science and engineering technology, the department is critical to the college and university to achieve the strategic goal of anticipating and responding to market demands in order to produce graduates who are prepared to address and adapt to the changing needs of the marketplace and society.

At the graduate level, there is currently a long-standing, college-wide PhD program, spanning all but two engineering disciplines of the college. (Recently, the electrical engineering (EE) and mechanical engineering (ME) departments were authorized to have their own PhD programs.) In this college-wide program, each engineering discipline functions essentially as its own individual program. With this Notice of Intent, we plan to separate the MSE portion of the remaining college-wide PhD program into its own program. The need for this action is detailed below.

Need as Suggested by Market Demand

The occupational categories included in job vacancy projections reported by the U.S. Bureau of Labor Statistics and Wisconsin Department of Workforce Development have limited utility when evaluating specific market demand for positions requiring doctoral preparation in materials science and engineering. Many of the established categories combine disciplines, as is the case for the occupation categories of post-secondary teachers, scientists, or managers. According to U.S. Bureau of Labor Statistics, long-term occupational projections in the U.S. for vacancies in the occupational area of Post-secondary Engineering Teachers are anticipated to grow by 12.5%, and in Wisconsin by 8% for the period 2020 to 2030; although, the projection data do not disaggregate by discipline within Engineering. Further, job openings in the occupational area of Materials Engineers are anticipated to grow by 5% in Wisconsin during this period. These projections include positions that require both undergraduate and graduate degrees¹. According to a survey on education requirements for materials engineers, 33% of respondents indicated a need for a doctoral degree². When viewed in combination, these data also suggest that as market demand for materials engineers increases, so will the demand for qualified post-secondary instructors who can train and prepare students to enter the workforce as materials engineers.

A more focused indicator of sustained market demand for the proposed program is placement data collected through the tracking of graduates of the Materials Science and Engineering track of the Ph.D. program. There is a local and national need for PhDs in Materials Science and Engineering. Our PhD graduates have been able to find jobs that are commensurate with this market demand. We have been

¹ Occupational projection data retrieved from <https://projectionscentral.org/Projections/LongTerm>

² Data retrieved from <https://www.onetonline.org/link/summary/17-2131.00>

able to gather data on 29 PhDs who graduated from the MSE Department in the last two decades. (Note that this data has not been gathered by UWM since we do not have a separate PhD program in MSE, and it is based essentially on the feedback provided by MSE faculty). Out of our 29 PhD graduates for which the data is available, 4 of them took their first job as university faculty (at the assistant professor or lecturer levels) in various engineering departments, 11 started work at corporate R&D, 5 were absorbed as senior/principal engineers in industry, 7 joined various universities as post-docs, and 2 started work as an executive director.

UW-Milwaukee future graduates who will hold a Ph.D. in Materials Science and Engineering will be even more competitive in the marketplace than those graduating from track in the umbrella Ph.D. in Engineering. CEAS faculty and staff repeatedly noted position advertisements that specify an earned Ph.D. in Materials Science and Engineering is required. This is especially so in academic postings. Also, doctoral programs enroll international students, many of whom return to their home country for their careers. In many foreign countries, the name of the degree in the diploma is critical and can impact hiring decisions.

Need as Suggested by Current Student Demand

Our program serves graduate students who work full or part-time in the Milwaukee area (place-bound), those who come to work with specific faculty on research, and those who have a desire to be in the Milwaukee area, as well as international students. Student demand is clearly demonstrated by sustained enrollments in the current Materials Science and Engineering track of the Ph.D. in Engineering program. An average of 16 Ph.D. students have been enrolled in the Materials Science and Engineering portion of the program in recent years, and this number has been relatively stable for a considerable time. The PhD enrolment in the MSE portion of the college-wide program for years 2019-2023 was 15, 16, 18, 12, and 16, for an average of about 16 PhD students in the MSE portion of the program. (The MSE department awarded PhD degrees to 1 student in 2017, 5 students in 2018, 2 students in 2019, 3 students in 2020, and 2 students in 2021.)

Overview of the Program

The proposed PhD Program in Materials Science and Engineering will essentially be the same as the MSE portion of the remaining college-wide PhD program. Curricular areas will be unchanged (covering typical graduate-level materials science and engineering content). There is no planned change in research focus – current areas of strength include metal casting, physical metallurgy, alloys, composites, energy storage, membranes, water filtration, and materials characterization.

Anticipated Program Outcomes: Typically, 3-4 PhD students graduate from the MSE portion of the remaining CEAS PhD program. We do not expect any significant changes in that number after the MSE program becomes a stand-alone program like the EE and ME programs. As stated below, the goal of this endeavor is to be able to attract higher-caliber students, and to greatly assist in data collection about the MSE program.

Learning Outcomes of the MSE PhD Program (same as the current remaining college-wide PhD program):

- a. Apply advanced knowledge of mathematics, science, and engineering to solve complex problems.

- b. Use modern tools or techniques to solve complex problems, conduct research, and analyze and interpret data.
- c. Demonstrate proficiency and competency in the area of specialization.
- d. Identify, formulate, and solve complex problems with an original and/or significant contribution to the field.
- e. Demonstrate a familiarity with research in a related or complementary discipline.
- f. Use quantitative methods appropriate to the field of research.
- g. Understand academic, professional and ethical responsibility.
- h. Communicate effectively via technical writing and oral presentations.

Methods of Assessment of Outcomes:

- i. Outcome (a) is assessed through achievement of the PhD Qualifying Examination.
- ii. Outcome (b) is assessed through the dissertation proposal hearing.
- iii. Outcome (c) is assessed through the Qualifying Examination and achieving a grade of B or higher in program of study.
- iv. Outcome (d) is assessed in the preliminary examination (identify and formulate), in the thesis (solve) and in any published results.
- v. Outcome (e) is assessed through achieving the required B or higher average in selected course work (9 minor credits) and in the preliminary examination.
- vi. Outcome (f) is assessed in the program of study's inclusion of appropriate course work with a grade of B or higher.
- vii. Outcome (g) is assessed in the required ethics and communication course(s) being developed with a grade of B or higher.
- viii. Outcome (h) is assessed in the Dissertation Proposal hearing and the Dissertation Defense.

The minimum degree requirement is 66 graduate credits beyond the Bachelor's degree with minimum credit distribution as follows: 21 credits in the major area; 9 credits in an approved minor area; 6 credits in mathematics and/or quantitative methods; 9 credits of approved electives; 3 credit CEAS Graduate Seminar (Ethics and Engineering Communication); A minimum of 26 credits, excluding dissertation, must be at the 700 level or higher; 18 credits of doctoral thesis. A minimum of 33 credits (including thesis) must be completed in the Ph.D. program at UWM.

A maximum of 33 credits may be considered for transfer from prior graduate work, including a Master's degree earned at UWM or elsewhere provided the course work taken falls within the appropriate areas and has earned a grade of "B" or better. Students entering the program without an applicable Master's degree are limited to a maximum transfer of 9 credits for courses taken elsewhere.

Admission Requirements

Admission standards will be the same as current admission standards for Engineering PhD.

Tuition Structure

Standard tuition and fee rates for graduate students will apply. In 2024-25, tuition and fees for Wisconsin residents enrolled full-time for eight credits is \$6,132.77 per semester, of which segregated fees total \$782.45 and tuition accounts for \$5,350.32 per semester. The corresponding non-resident tuition and segregated fees are \$12,848.29 for full-time enrollment of eight credits, of which \$782.45

accounts for segregated fees and \$12,065.84 accounts for tuition. Tuition and fees for resident students enrolling part-time for three credits is \$2,471.27, of which \$464.90 is for segregated fees and \$2,006.37 is for tuition. Credits taken in the College Engineering and Applied Science are assessed an additional “differential tuition” of \$87.50 per credit (max \$700 per semester). Most full-time Ph.D. students in Engineering are graduate assistants and receive tuition remission as a benefit of their appointments.

Projected Time to Degree

A full-time student with a completed master’s degree would typically complete the Ph.D. in 3-4 years. For a student entering with a baccalaureate degree, the time to complete the degree would typically be 4-5 years.

Accreditation

No specialty accreditation requirements are anticipated.

Institution and University of Wisconsin System Program Array

Alignment with Institutional Mission, Strategic Plan, and Existing Program Array

The current joint program, being focused on research and advanced education, clearly serves the broad UW-Milwaukee mission for discovery, research, and education, and supports the generation of new knowledge for the development and betterment of society. The new, split-off MSE program will serve the same purpose.

Need for the Program and Relationship to Existing Programs

As discussed above, at present there is a college-wide PhD program In Engineering and Applied Science. The materials science and engineering portion of that program has approximately 23 graduate students, divided into 16 PhD and 7 MS students. The proposed program is simply to split off the materials science and engineering portion of that existing program, to become a PhD in Materials Science and Engineering. Department faculty feel that this is an appropriate move for several reasons. First, there is some student reluctance to have a PhD degree that is, officially, in Engineering, rather than in Materials Science and Engineering. We feel that a more specific degree name would aid in attracting top PhD student candidates to the program. Second, department faculty would like more autonomy in administering the program, including scheduling and evaluation of the PhD Qualifying Exam. Third, having a combined college-wide program makes it difficult to collect data on our (MSE) students and graduates, as all PhD students in the college are, officially, in Engineering rather than Materials Science and Engineering. Related to data collection for our own internal purposes, the presence of a college-wide PhD program adversely affects us in rankings, such as US News and World Reports and similar venues. We do not appear in these rankings of materials science and engineering PhD programs simply because we do not have a PhD program in materials science and engineering (despite the fact that we, essentially, do have such a program of longstanding nature). Lastly, department faculty feel that having a PhD Program in Materials Science and Engineering would be helpful for faculty and student recruitment.

Impact on Madison's MSE PhD Program: We do not expect that this program will have any effect on the MSE PhD program in Madison. Our student pool is largely drawn from two groups. One is engineers working in the industry in Milwaukee. They choose UWM because it is convenient, and for them, Madison is too far to commute. The creation of a stand-alone MSE PhD program will not affect these students. The other main group is foreign students, but our program and the program at Madison have different admission criteria (which is the current situation and which will not change in the proposed program). As such, it is clear that the proposed program will neither produce unnecessary duplication within the UW System, nor impact the program at Madison.

Anticipated Resources

Since this is essentially a splitting-off of an existing program, no additional resources are required. The college will still manage admissions processing, as occurs currently. Currently, there are 6.5 full-time faculty and several adjunct faculty supporting the program.

Additional Fast Track Elements

As this is elevation of a track to a major, with no change in curriculum or need for additional resources, we seek the fast-track approval. The proposed CIP will share the same first 2 digits as the current program from which it is being elevated (14 = Engineering). The proposed program will be delivered consistent with UW System, state, and federal guidelines and policies.