

# Advanced Materials Engineering

The design and manufacture of engineering devices and systems is heavily influenced by the materials used. Improved performance results with the appropriate choice of material and materials processing methodology. Understanding the relationships between material composition, processing, microstructure, and material properties can enhance opportunities for mechanical engineers in almost all application areas. This thrust allows students to obtain a concentration in materials engineering as a basis for practice and graduate study in this field.

## Industry Applicability

This certificate program area is appropriate to prepare mechanical engineers for jobs in industry that deal with one or more of the following:

- Selection of materials for devices or structures
- Service of materials in difficult or extreme environments
- Manufacturing, materials and products
- Critical analysis of material failure events

## Selected Examples

1. *Materials in extreme environments: The utility of devices and structures are often limited by the performance of materials in extreme environments. Materials used in turbine engines, in down-hole applications for oil and gas extraction, and in the human body can experience elevated temperature and/or chemically aggressive environments. Understanding materials interactions and appropriate materials selection for these environments is key for application performance. New materials development including alloy design and new coating materials and processes are driving improved properties and performance.*
2. *Advanced materials in the automotive industry: Improved vehicle performance and efficiency are driving industry to move from traditional steels to advanced materials including high strength steels and lighter weight aluminum and magnesium alloys. Challenges for these materials include the need for high formability, high strength, and low cost. Improved alloy design and processing*

will continue to enhance the properties of these materials and increase their utilization in vehicles.

3. *Materials for rechargeable batteries:* Modern electronics and electric vehicles require lightweight and portable energy storage. Improved material compositions and microstructures for cathodes have driven enormous improvements in Li-battery performance for the past three decades. Along with continued improvements in cathode materials, new materials are now being considered for new battery chemistries that will lead to even higher energy densities with enhanced safety.
4. *Materials for additive manufacturing:* During the first 20 years since additive manufacturing was invented, the market has primarily been for polymers used for prototyping and modeling. Additive manufacturing of polymer, metal and ceramics for structural components is increasingly common and requires knowledge for how materials respond to highly non-equilibrium processing conditions. New materials and improved manufacturing will result in continued increases in custom-made devices produced using additive manufacturing.

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## Required Courses

1. M E 336, Materials Processing
2. M E 378K Mechanical Behavior of Materials

## Other Undergraduate Elective courses (select two)

1. M E 350 Machine Tool Operations for Engineers
2. M E 359 Materials Selection
3. M E 378D Failure Analysis
4. ME 349 Corrosion Engineering
5. ME 377K Projects in Mechanical Engineering (recommended for students interested in graduate school)

For course descriptions visit the [University Catalog](#).

## **Organizations and Societies**

Materials Research Society (MRS), Materials Advantage (includes TMS and American Ceramic Society), Electrochemical Society (ECS)