ESM 532: Materials Processing Spring 2017

Friday 10 AM-1230 PM

Room 3014 Humanities (subject to change)

Modern engineering systems require complex assembly of a variety of materials each of which must meet stringent guidelines of design and performance. Much of advanced engineering systems in energy, electronics and even in medicine rely on advanced structural and functional materials Examples of significant embodiments of this complex material integration for example are: integrated circuits for logic and memory devices and aircraft engines for structural materials.

For effective material utilization they need to be manufactured to exacting specifications in high volume and at a relatively low cost. A critical step in this endeavor is to first produce materials to their specific structure and composition following which they have to converted to useful shape to meet the entiretty of form, fit and function. There are numerous ways where materials can be converted to useful forms. This is the step referred to as materials processing. From iron age type metal working to molecular beam epitaxy, materials processing encompasses not only thousands of different processes but varying degrees of sophistication. There are many sub-steps of processing including extraction from raw materials to synthesis of functional forms to the ultimate utilization in a manufactured state.

Since there are thousands of different processes used for materials conversion, the selection of a particular process is based not only a given material but also on the ability to convert to a useful subsystem for further integration into a component. As such the 532 class is to understand the methodology by which materials are integrated into the design of a component or subsystem which is based on their functionality and ability to be manufactured. To accomplish we will resort to a systems approach to materials and process selection. Throughout the semester, students either as individuals or as groups will select and important contemporary technology rooted in a strong materials processing agenda and go through the exercise of identifying and analyzing specific combinations of materials and processes that facilitate their integration.

Over the years, students have addressed contemporary topics such as Li-ion batteries, light emitting diodes, integrated circuits, solar cells, thermoelectrics, fuel cells, tissue engineered constructs, thermo-structural materials systems etc. Of particular interest is technologies involving layer by layer assembly and additive manufacturing where in materials integration is confined by geometry and functionality. A second area of interest is to examine manufacturability of innovative new materials concepts. Here again, the motivation needs to be system driven.

After identification of topics for system based materials and process development, each week student(s) will work to highlight key design elements, materials selection and manufacturable process identification for their given system. Students will be expected to prepare a few slides and be willing to present for peer-to-peer learning under the guidance of the instructor. At the end of the semester an integrated presentation will need to given in front either faculty or university staff along with a 4-5 page written document.