Materials Science & Engineering Graduate Seminar

Wednesday, February 26, 2020, 4:10-5:00 PM, FASB 295

Jake Graser

Synthesis and Characterization of Machine Learning Predicted Thermoelectric Materials

Thermoelectrics are unique as they can be used in energy converters to boost efficiency as well as mechanisms for solid-state cooling for use in applications of refrigeration and circuit cooling. These thermoelectric devices have had a long history in power generation for spaceflight and satellites and are known for their durability and reliability. The question then stands as to why we are not incorporating thermoelectrics across all devices. Thermoelectrics have historically been hindered by low efficiencies as well as high cost due to rare or toxic elements such as tellurium and lead. Recently, new computationally focused high-throughput methods have been implemented for material discovery. Yet, how well do these algorithms actually work? In this talk I will discuss the synthesis and characterization of Cu_3TaS_4 that has been predicted using a new technique recently published called Mat2Vec and evaluate how this prediction compares to experimental.

Clark Nielson

Porous Fluorapatite Bone Scaffolds: From tissue replacement towards tissue regeneration

An unmet need exists in orthopedic surgery for regenerative bone substitutes for load-bearing applications in the treatment of critical-sized defects. Synthetic hydroxyapatite has been used due to its similarity to the mineralized portions of real human bone, but is resorbed too quickly for load-bearing applications. Many studies have demonstrated that fluoridated HA, or fluorapatite (FA), is resorbed more slowly than HA in vivo, and supports improved osteogenic cell differentiation over HA, making it a strong and less-studied candidate for bone regeneration. The purpose of our study experiment was to study the influence of various colloidal processing techniques in the creation of porous fluorapatite bone scaffolding. A rapid-prototyping technique was utilized in order to identify the ceramic-processing factors that play the biggest role in the microstructure, surface features, architecture, and subsequently the mechanical strength, of the final sintered scaffolds. Special attention is paid to the production of a stable fluorapatite suspension through colloidal processing, and towards tailoring the ceramic gel-casting procedure used to produce the samples. Porous FA scaffolds were produced with adequate porosity and pore interconnectivity for potential use in the regeneration of bony defects. The results from preliminary animal testing showed that purely FA scaffolds can be resorbed and stimulate bone regeneration in vivo.