Materials Science & Engineering Graduate Seminar

Wednesday, November 27, 2019, 4:10-5:00 PM, WEB 1230

Levi Gardner

PhD candidate, Metallurgical Engineering

Synthesis and Characterization of Sintered H-Y Zeolite-Derived Waste Forms for Dehalogenated Electrorefiner Salt

Glass-bonded sodalite is currently the most promising ceramic waste form for the disposal of electrorefiner waste salt from pyroprocessing of used nuclear fuel. Despite its excellent chemical durability, this waste form's effectiveness is hindered by limited fission product loading. This presentation provides an overview of an alternative processing path with higher fission product loading in its final form. This path involves the dehalogenation of waste salt via ion exchange with H-Y zeolite and consolidation via sintering. X-ray diffraction, differential scanning calorimetry, density measurements, and scanning electron microscopy were used to evaluate phase transitions and densification in the salt cation-loaded zeolite during sintering. The chemical release behavior of the sintered waste form in solution was measured using accelerated leach testing. Improvements in final storage volume and chemical durability over the baseline ceramic waste form are highlighted.

Xiaojuan Ni

PhD candidate, Materials Science & Engineering

Percolation Model for Multicomponent Nanocarbon Composites: Synergistic Effect and the Critical Role of Nematic Transition

Both 2D and 3D percolation models have been developed on the basis of Monte Carlo simulation to investigate the percolation behavior of an insulating matrix reinforced with multiple conductive fillers of different dimensionalities. Impenetrable fillers of large aspect ratio are found to preferentially align with each other to maximize the packing entropy rather than forming randomly oriented clusters. This entropy-driven transition from isotropic to nematic phase is shown to critically affect the percolation threshold. It suggests that an isotropic phase with a smaller nematic order parameter leads to a reduction in percolation threshold. In addition, a combination of two fillers with different dimensionalities has the synergistic effect, which can achieve a working concentration below the percolation threshold of single component system. This synergy is further validated by the experiments of electrical conductivity in multicomponent multidimensional composites. Our work provides an important theoretical basis for designing the conductive networks and predicting the percolation properties of multicomponent nanocarbon composites. (Nanotechnology, 29, 075401, 2018 and Nanotechnology, 30, 185302, 2019)