In situ Neutron Diffraction Studies: Crystal Growth and Ion Exchange

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In-situ neutron diffraction experiments at non-ambient conditions can be used to follow chemical processes including crystal growth and ion exchange. Two examples, one focusing on crystal growth and one on ion exchange will be presented. 1) Exploratory flux mediated crystal growth is one route to discovering novel inorganic compounds, including metastable ones; however, the method does not reveal the existence of intermediates or transient species, as only the final products are isolated at the end of the reaction. Uncovering the presence of any potential intermediates or transient species is, thus, of interest and can be achieved via *in-situ* X-ray or neutron diffraction crystal growth studies to observe, in real time, the processes occurring, including phase formation and crystal growth. The results from our study investigating the processes involved in the crystal growth of $La_4Mo_2O_{11}$ and $Ce_4Mo_2O_{11}$, two reduced Mo^{5+} containing oxides synthesized in a NaCl/CsCl eutectic flux, and studied via *in-situ* diffraction experiments at the POWGEN beamline at the Spallation Neutron Source will be presented. 2) Salt-Inclusion Materials (SIMs) are a subset of a unique family of hierarchical structure types that consist of a covalent metal oxide framework containing voids filled by an ionic salt lattice. The salt lattice can be exchanged for a different salt and the process followed in-situ using neutron diffraction. Preliminary results on the ion exchange of Cs_3F in $[Cs_3F][(UO_2)(Si_4O_{10})]$ with other salts will be presented.