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Investigating Local Defect Structures in Nuclear Waste Form Materials

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For the past 30 years, the development of durable materials for radionuclide immobilization has been central to efforts to dispose of wastes generated by the nuclear fuel cycle. There still exist, however, large gaps in the understanding of fundamental modes of waste form degradation under repository conditions. Comprehensive evaluation of waste form performance, including resistance to corrosion, requires detailed knowledge of the atomic-scale effects of long-term self-irradiation. We have recently shown that pair distribution function (PDF) analysis of neutron total scattering measurements can be applied to uniquely characterize radiation effects in a wide range of waste form materials, including fluorite-derivative pyrochlores, actinide oxides, and glasses. These measurements allow a detailed analysis of both cation and anion defect behavior, and short range order and disorder, which is particularly important for the investigation of aperiodic glasses. Recent results have shown complex disordering in pyrochlores, and oxygen defect clustering in actinide oxides.

Summary

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