Understanding the driving forces for microstructural evolution in ceramics subject to ion irradiation

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Irradiation induced microstructural changes can have significant consequences for the mechanical properties of a material. This is well documented in metallic systems but the same phenomenon are not as well understood in ceramics. For example, the successful strategy using nanocrystalline or nanolaminate microstructures to increase the defect sink density has been demonstrated in a wide range of metallic systems; however, when the same strategy is employed for ceramics growth of the nanocrystalline grains may lead to microcracking. Here we will use a combination of in situ and ex situ ion irradiation to elucidate the underlying defect fluxes responsible for different microstructural responses. Specifically, we will present examples from porous yttria stabilized zirconia ceramics. A comparison of dopant segregation near grain boundaries and pore surfaces will be used to understand interfacial mobilities, which can be used to predict localized strain and possible failure.

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