Effect of heavy ion irradiation on α’ precipitate stability in Fe-15Cr

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High-Cr ferritic-martensitic (F-M) steels are candidates for use as nuclear reactor components due to their adequate corrosion resistance and resistance to swelling. However, these steels are susceptible to the formation of Cr-rich α’ precipitates at low to intermediate temperatures (below ~500°C) in both thermal and irradiation environments leading to hardening and embrittlement. α’ precipitates are not consistently observed under heavy ion irradiation and are noted to have dissimilar properties (radius, number density, concentration, volume fraction) than α’ formed under neutron, proton, or electron irradiation or thermal aging. Here, we seek to understand the role of damage rate and cascade size on existing α’ precipitates subjected to heavy ion irradiation in model alloy Fe-15Cr. We established a steady state α’ precipitate population in the samples by 2 MeV proton irradiation at 400°C with a damage rate of $1x10^{-5}$ dpa/s to 1 dpa. We then subjected these samples to further heavy ion irradiation at variable damage rates to investigate the roles of damage rate and cascade size on the ballistic dissolution of α’ precipitates. Atom probe tomography (APT) analysis revealed a more prevalent ballistic dissolution at higher damage rates ($\sim10^{-3}$ dpa/s), as exhibited by the reduced precipitate size and chromium concentration.