Effect of carbon on the evolution of early stage radiation defects in equi-atomic CoCrFeMnNi high-entropy alloys

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Due to the excellent fracture toughness, irradiation and corrosion tolerance, High-Entropy alloys (HEAs), or concentrated multicomponent alloys have been drawing much attention and have the potential to be developed as new structural materials in extreme condition. Recent research showed that carbon addition improved the strength and ductility simultaneously in face center cubic (fcc) HEAs [1, 2].

In order to understand the carbon effect on microstructure evolution in early stage irradiation damaged HEAs, 150 keV hydrogen ions were implanted in C-containing equi-atomic CoCrFeMnNi high-entropy alloys at room temperature. The irradiation fluence were ranged from 2.5×10^{14} up to 2.5×10^{17} ions/cm^2 and the damage dose were estimated between 0.001 dpa and 1dpa by using SRIM calculation. Doppler broadening spectroscopy based on slow positron beam [3] was utilized to characterize the radiation defects and the microstructure evolution in as-irradiated samples. The results indicate that mono-vacancies generated in samples during early stage irradiation process, and the irradiation induced point defects migrated and accumulated to vacancy clusters as the irradiation dose increasing. The addition of carbon interstitials interact with irradiation vacancies to form C-vacancy complexes, which suppress the migration and coalesce of point defects and furthermore enhanced the irradiation tolerance of CoCrFeMnNi high entropy alloys.

References
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