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APT characterization of irradiation-induced evolution of nano-particles in ODS steels

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Oxide dispersed strengthened (ODS) ferritic/martensitic steels have been extensively studied in various fusion and fission materials R&D programs. Due to their high strength at high temperatures, ODS steels are tentative structural materials in ADS. The objective of this study is to determine irradiation-induced evolution of nano-sized clusters in ODS steels. The selected ODS steels are Eurofer-ODS developed by KIT Germany for fusion materials program and 9Cr and 14Cr-ODS steels developed by CEA France for fuel claddings. The samples were irradiated in SINQ Target-7 and -10 to doses up to 20 dpa.
Two kinds of particles were analyzed, including pre-existing oxide particles (ODSP) and irradiation-induced nano-particles (INP). The size, volume density and composition ODSP and INP have been quantitatively characterized using atom probe tomography (APT). The results showed that the INP are composed of Si, Mn, Ti, Sc, Ca and K, where Ti, Sc, Ca, and K are spallation transmutants produced during irradiation. The evolution of ODSP depends on irradiation temperatures, which may be attributed to different mechanisms.

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