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Irradiation response of SIMP steel in STIP

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Ferrite/martensite (F/M) steels containing 9-12% chromium are considered as one of the most competitive candidate materials for advanced nuclear energy systems due to its excellent properties such as resistance to irradiation swelling, high thermal conductivity and low thermal expansion coefficient. SIMP steel is a novel F/M steel with about 10.24%Cr and 1.2%Si specially developed for the CiADS (China Initiative Accelerator Driven System) application. Preliminary test results revealed showed good corrosion resistance to lead-bismuth eutectic (LBE) at 550℃. To investigate it irradiation response, specimens of two batches of SIMP steel were irradiated in Target 10 and 13 of the Swiss spallation neutron source (SINQ), namely STIP-VII and -VIII.

Tensile specimens of SIMP steel were irradiated in STIP-VIII at temperatures between about 130 and 270 ℃ to doses between 4 and 10.4 dpa. Tensile tests were performed at both room temperature (RT) and irradiation temperatures. The fracture surfaces of selected tensile tested specimens were characterized by scanning electron microscopy (SEM). Moreover, the microhardness was measured from the grip section of tensile specimens.

Irradiation-induced hardening was shown by the tensile and microhardness results. At RT, total elongation of irradiated specimens reduced from 18% of unirradiated specimens to about 6%. At higher temperatures between 150 and 300 ℃, the total elongation continuously decreases with the test temperature to about 12% and 4% for unirradiated and irradiated samples, respectively. The fracture morphology of the samples showed that the fracture mode changed from ductile to quasi-cleavage fracture with increasing dose.

The dose of the specimens irradiated STIP-VII reached 23 dpa. They will be tested also at higher temperatures. The results will be included in this presentation.

Primary authors: YANG, Yushan (Institute of Modern Physics, Chinese Academy of Sciences); DAI, Yong (Paul Scherrer Institut); WANG, Zhiguang (Institute of Modern Physics, Chinese Academy of Sciences, P.R. China); SHEN, Tielong (Institute of Modern Physics, Chinese Academy of Sciences, P.R. China)

Presenter: YANG, Yushan (Institute of Modern Physics, Chinese Academy of Sciences)

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