RELATIONSHIP OF VOID SWELLING AND DISPERSOID STABILITY IN VARIOUS ODS FERRITIC-MARTENSITIC ALLOYS IRRADIATED WITH SELF-IONS TO VERY HIGH DPA LEVELS

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Recently published studies conducted in the Ukraine have shown that ferritic and ferritic-martensitic alloys irradiated with 1.8 MeV Cr-ions resist rapid swelling for hundreds of dpa before accelerating to~0.2%/dpa thereafter, with the transition highly dependent on composition and grain structure, varying from 100-500 dpa. More recent studies now focus on oxide-dispersion-strengthened (ODS) alloys irradiated with 1.8 MeV Cr-ions and/or 3.5 MeV Fe-ions, the latter at Texas A&M University. Results are presented here for an EP-450 ODS variant, MA956, MA957, and 14YWT, these alloys having dispersoids in a ferrite matrix, and also a unique 9Cr duplex ODS alloy with dispersoids in both ferrite and tempered martensite phases.

A number of major questions are addressed. Is void swelling delayed by dispersoids? Are the dispersoids stable under irradiation? Are the two phenomena directly or indirectly related? Does the dispersoid-suppressed swelling arise from their role as sinks for point defects or more from their pinning of the nano-grain microstructure to resist radiation-induced recrystallization?

In MA956 dispersoids were not used to produce nano-grains and the overwhelming majority of voids nucleate at relatively low dose directly on the surfaces of the dispersoids. The dispersoids in MA956 are also unstable during irradiation, first becoming amorphous and then dissolving. In other alloys such as MA957 and 14YWT the dispersoids are much more stable, and the transient regime of swelling persists to 400-500 dpa. The voids in highly nano-structured alloys appear to be aligned in internal patterns associated with the deformation texture. It also appears that the role of dispersoids in delaying accelerated swelling arises primarily from their action to pin and maintain the nano-grain structure such that grain boundary denuding is a significant contribution. Swelling observed in this study appears to be dependent not only on composition but also on grain structure, most easily observed in duplex alloys.

TOMOGRAPHIC ATOM PROBE STUDY OF ODS STEEL 12Cr-1.1W-0.2V-0.3Ti-0.3Y_2O_3

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One of the important problems for advanced fission and fusion power plants is the development of structural materials for the reactor core. Operation characteristics of new