

Nano-oxides and microstructural evolutions of oxide dispersion strengthened steels throughout their fabrication process

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Abstract: Studies are carried out in the Service de Recherches Métallurgiques Appliquées (SRMA) from CEA on fuel cladding for the 4th generation of Sodium cooled Fast nuclear Reactors (SFR). Indeed, the operating conditions imply to develop new materials. Alloys strengthened by nano-size oxide dispersion (ODS as Oxide Dispersion Strengthened) are candidate thanks to (i) their good swelling resistance under irradiation and (ii) their high temperature creep strength improved notably by nanoparticles. These nanoparticles results from the material elaboration by powder metallurgy. This project deals with the precipitates analysis. Indeed, a better understanding of the precipitates formation and of their role on the final microstructure would allow controlling the process range and/or at least controlling the obtained precipitation. It aims at: giving understanding of the particles evolution (apparition step, formation kinetic, chemical composition evolution) and microstructure evolution during annealing and consolidation of ODS steels, of different chemical compositions grades initially as powder and/or cold consolidated powder, by coupling experiments (analysis by Small Angle X-Ray Scattering of the precipitation kinetic and Y/Ti ratio evolution during in situ heating precipitation characterization by Small Angle Neutron Scattering, Transmission Electron Microscopy - analysis of the evolution of the microstructure by X-Ray Diffraction on Soleil synchrotron and characterizations by Scanning Electron Microscopy coupled with Electron Back-Scatter Diffraction analyses) and modeling (precipitation thermos-kinetic models).