CREEP BEHAVIOUR AT HIGH TEMPERATURE OF A STABILIZED AUSTENITIC STEEL FOR GEN-IV NUCLEAR POWER PLANTS

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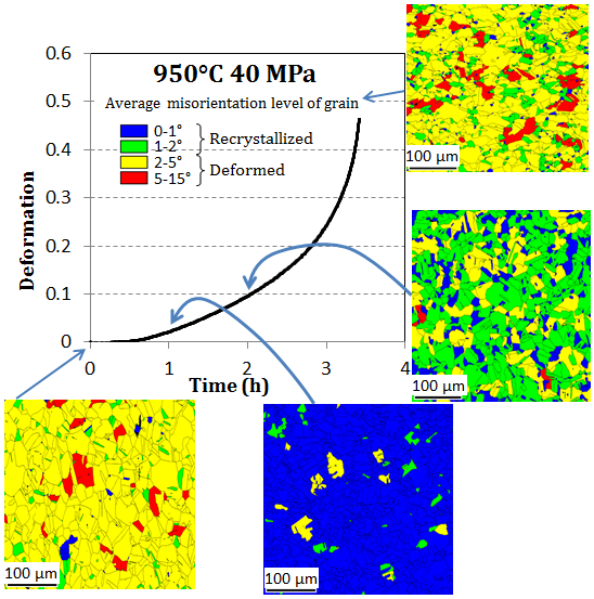

- Softening phenomena (recovery, recrystallization) and precipitation were characterized from aged samples
- The viscoplastic behaviour is dominated by tertiary creep at 950°C
- Dynamic recrystallization at 950°C is completed as soon as 30 min
- Ductile fracture is mainly observed

Abstract:

ASTRID is a fast-reactor prototype for the 4th generation of nuclear power plants. The material used for fuel cladding is a cold-worked austenitic stainless steel called AIM1. In case of incidental situations, the cladding might rapidly reach higher temperatures (700-950°C) where its stability might be affected.
Isothermal creep tests up to 1000°C under a wide range of stress levels enable to study viscoplastic flow, microstructural evolution under stress and damage/failure processes. In order to evaluate the effect of loading, microstructural characterizations (precipitation, recovery, and recrystallization states) on stress-free thermally-aged samples were also performed and compared with *post-mortem* examinations of creep specimens.
Up to 750°C, AIM1 shows better creep strength than previous generations of 15-15Ti grades. Beyond 750°C, dislocation mobility increases which promotes recovery and recrystallization processes. As a consequence, competition between work hardening due to viscoplastic deformation and softening due to dynamic recovery takes place. At 950°C, viscoplastic flow is strongly affected by recrystallization during creep test, especially in the tertiary stage. Softening due to recrystallization leads to longer tertiary stages and higher ductility during tests under lower stress levels (about 40 MPa applied stress). Ductile fracture predominates at any temperature.
Characterizations on thin foils and carbon extractive replicas showed a large variety of precipitates, such as Cr-rich borides, phosphides, and Cr- and Ti-rich carbides.