

R&D of advanced stainless steels for BWR fuel claddings (3)

(3) Mechanical properties of FeCrAl-ODS Steels

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We are pursuing research and development on the advanced stainless-steel fuel cladding tubes with high accident tolerance to use in BWR. In this presentation, as a part of the series presentation, the microstructure and mechanical properties of FeCrAl-ODS steel material subjected to different final heat treatments were studied.

Keywords: FeCrAl-ODS Steels, Cladding tube, Microstructure, Mechanical properties

1. Introduction

Both the grain structure and mechanical properties of the fuel cladding tubes are important issues to design the material for high temperature conditions and probable accident of nuclear reactor. In this study, we compared the microstructure and tensile properties of FeCrAl-ODS steels plates and cladding tubes in different extruded, recovered and recrystallized conditions and propose the material for the application.

2. Experimental

FeCrAl-ODS steel material with nominal composition of 12Cr-6Al-0.5Ti-0.4Zr-0.5Y₂O₃-0.24Ex.O (wt. %) was studied after mechanical alloying and hot extrusion at 1100°C and 1150°C. The grain structure and crystallographic texture was evaluated by EBSD. The mechanical properties were studied by tensile test up to 800°C with a strain rate of 10⁻³/sec.

3. Results

The cladding tube fabricated from bars extruded at 1100°C had a higher yield strength than that at 1150°C up to 500°C with a lower ductility. Above 500°C, the trend of strength and ductility change in reverse condition. The change in trend of strength and ductility with increasing temperature is attributed to work hardening and dynamic recovery mechanisms. The results of different extrusion temperature were evaluated based on the differences in crystalline texture as large grains of (110) <211> texture in 1100 °C extrusion temperature in compared to two texture components of (110) <211> and {111} <112> formed with smaller grain size in 1150 °C.

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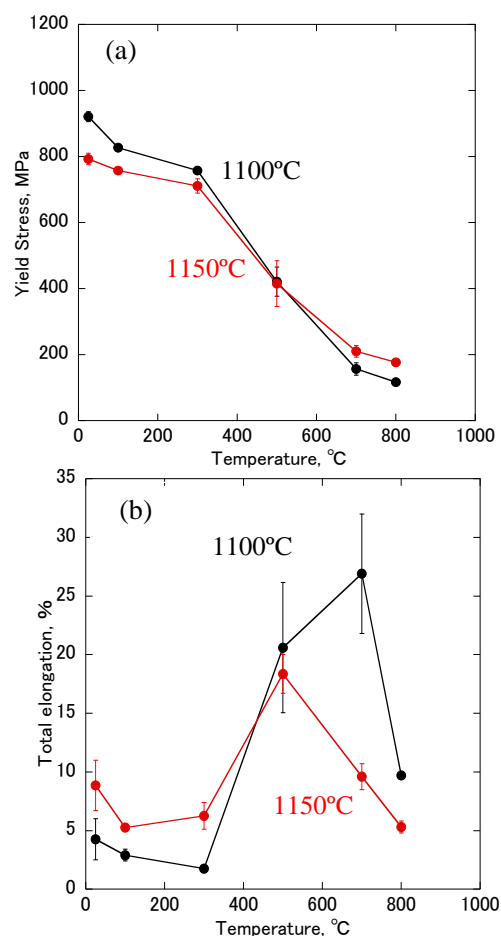


Fig. Change of a) yield strength and b) total elongation of cladding tubes fabricated from bars extruded at 1100°C and 1150°C