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Development and characterization of advanced Fe-10Al-4Cr-4Y_2O_3 ODS alloy for applications up to 1300 °C

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The powder of the novel Fe-10Al-4Cr-4Y_2O_3 ODS alloy with 5% volume fraction of nano-dispersoid was produced from powders of individual components with addition of metallic Yttrium by mechanical alloying. Then the powder was canned, consolidated by hot rolling and annealed to provoke secondary recrystallization. The resulting structure is composed of coarse grained (often mm in size) microstructure with homogeneously distributed 20-30 nm sized Y_2O_3 dispersoid. The extensive analysis was focused on the effects of processing and alloying elements on the microstructure and strength measured by tensile tests at 1100 °C with strain rate of 10^{-6} s^{-1} [1]. Furthermore, coarsening of the dispersoid at 1200–1400 °C up to 72 hours and oxidation kinetics in flowing air environment at the same conditions were characterized. The results indicate very high oxidation resistance compared to similar materials and slow rate of dispersoid coarsening. Furthermore, the mechanical tests show excellent tensile creep properties up to 1300 °C. The best strength of the ODS alloy corresponds to microstructure consisting of very coarse grains elongated in direction of applied stress as shown in Fig. 1.

Keywords: ODS alloy, creep, oxidation, dispersoid coarsening

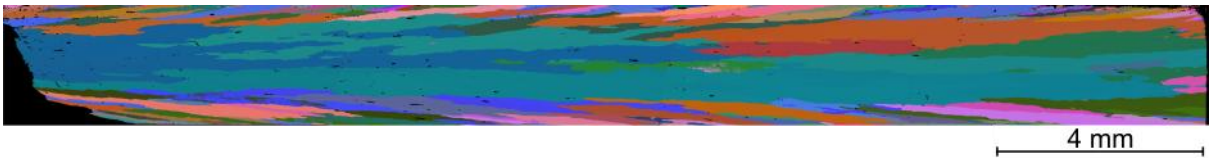

Fig.1. Euler color map of optimal microstructure with grains elongated in direction of applied stress

References:

[1] Svoboda et al., Substantial Improvement of High Temperature Strength of New-Generation Nano-Oxide-Strengthened Alloys by Addition of Metallic Yttrium, Materials, 15(2), 2022, 504.