Study on Microstructure Control of Reduced Activation F82H-ODS Ferritic Steels

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The purposes of this research are improving the microstructure and high temperature properties of reduced activation F82H-ODS ferritic steel and 9CrODS ferritic steels, furthermore, we try to reveal the strengthening and phase transformation mechanism in ODS ferritic steels.

The reduced activation F82H-ODS ferritic steel is based on J1-lot developed for the advanced fusion blanket material to increase the coolant outlet temperature. The structure control and phase formation mechanism were investigated. The area fraction of the ferrite phase was reduced, when the specimens were annealed at 1250 °C for long enough time inducing oxide particle coarsening. The effect of oxide particles on α-γ transformation was investigated, and ferrite formation is ascribed to pinning of α-γ interfacial boundaries by the dispersed oxide particles. This ferrite is meta-stable, and designated as residual-ferrite. A hot-rolling was conducted at the temperature above A_{r3} of 716 °C, and its effect on the microstructure and tensile strength in reduced activation F82H-ODS ferritic steel was evaluated, comparing together with normalized and tempered specimen. It was confirmed that hot-rolling leads to slightly increased fraction of the ferrite and highly improved tensile strength. This ferrite was formed by transformation from the hot-rolled austenite during cooling due to fine austenite grains induced by hot-rolling. The coarsening of the transformed ferrite in hot-rolled specimen can be attributed to the crystalline rotation and coalescence of the similar oriented grains. The improved strength of hot-rolled specimen was ascribed to the high dislocation density and replacement of easily deformed martensite with the transformed coarse ferrite.

For 9CrODS ferritic steels, we investigate effects of hot-rolling at the γ-austenite region and subsequent cooling at different cooling rate that could modify the microstructure and mechanical properties. The specimens were prepared by different processing with hot-rolling and different cooling rate. The hardness and high-temperature tensile properties were measured. Microstructure was analyzed by

means of EBSD inverse pole figure and kernel average miss-orientation angles. The hot-rolled and then air-cooled specimen has the highest tensile strength. The furnace-cooled specimen also has better tensile strength at 700°C than air-cooled specimen at normalized condition. The high-temperature strength of 9CrODS steel is significantly improved with increasing grain size that can be induced by hot-rolling or furnace-slow cooling, where the localized grain boundary deformation can be suppressed.