CURRENT STATUS OF ODS ALLOYS

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Abstract

We gratefully dedicate this talk to Professor Shigeharu Ukai, who has been the long-time world leader and keeper of the flame for research on oxide dispersion strengthened (ODS) steels and nanostructured ferritic alloys (NFA). First we show that the materials science underlying NFA development has emerged as a remarkably comprehensive and high quality body of research. Understanding the thermodynamics, kinetics and sequence of events has guided composition selections and billet processing paths needed to form and sustain performance enabling nano-oxides (NO), and the balance of other key NFA microstructures, although future improvements are certainly possible. NO are predominantly complex oxide $Y_2Ti_2O_7$ pyrochlore phases, and their role in providing outstanding mechanical properties and, especially, the unique irradiation tolerance of NFA is briefly described. One focus of our talk is on thermomechanical processing of defect-free NFA components, which is work in progress. The importance of developing new databases and design tools for high temperature applications, including defect tolerance and time-dependent loading (short, long and transient times) is also argued. Two other major issues are the cost and availability of sufficient quantities of NFA for industrial applications. We describe plans for, and recent progress on, the production of large heats of ODS steels and NFA that will be consistent with their selective application to advanced fission and fusion energy systems.