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The enhancement of high temperature deformation resistance for V-4Cr-4Ti alloys

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Vanadium alloys, especially those with the compositions of V-4Cr-4Ti, are important candidate materials for blanket in future fusion reactors. In the past one decade, to enhance the high temperature mechanical properties, which equates with safely increasing the operation temperature, is one of the main efforts made to V-4Cr-4Ti alloys. According to dislocation theory, to properly increase defects density is an efficient way to strengthen practical alloys. Moreover, for high temperature application, the thermal stability of such defects is required.

This work presents various commercial techniques used for strengthening the V-4Cr-4Ti alloy, including alloying, cold work, aging and mechanical alloying (MA) as the highlighted topic. With characterization of the tensile and creep properties at elevated temperatures coupled with investigation on deformation mechanisms of the resulted V-4Cr-4Ti materials, more work is then focused on the nano-particle dispersion strengthening. In the experiments, different starting powders, carbide dispersion agents and MA routes are used. Results show mechanically alloyed V-4Cr-4Ti alloy with Ti₃SiC₂ addition exhibits promising strength at both room temperature and elevated temperatures. Especially, its steady creep rate is almost one order lower than melted V-4Cr-4Ti alloy. The mechanism is considered as the thermal stable nano-particles resisted dislocation motion at high temperature, and is worth being introduced to the strengthening of other structural materials.

Eligible for student paper award?

No

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