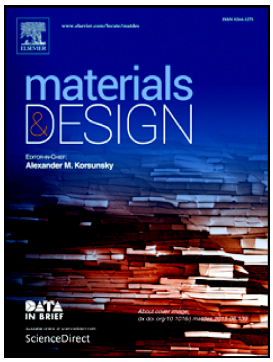
Accepted Manuscript



Effect of Sc on the microstructure and room-temperature mechanical properties of Nb-Si based alloys

Yonglin Huang, Lina Jia, Zuheng Jin, Bin Kong, Yueling Guo, Jiangbo Sha, Hu Zhang

PII: S0264-1275(18)30756-1
DOI: doi:10.1016/j.matdes.2018.10.001
Reference: JMADE 7415

To appear in: *Materials & Design*

Received date: 21 June 2018
Revised date: 22 September 2018
Accepted date: 1 October 2018

Please cite this article as: Yonglin Huang, Lina Jia, Zuheng Jin, Bin Kong, Yueling Guo, Jiangbo Sha, Hu Zhang , Effect of Sc on the microstructure and room-temperature mechanical properties of Nb-Si based alloys. Jmade (2018), doi:10.1016/j.matdes.2018.10.001

Effect of Sc on the microstructure and room-temperature mechanical properties of Nb-Si based alloys

Yonglin Huang, Lina Jia*, Zuheng Jin, Bin Kong, Yueling Guo, Jiangbo Sha, Hu Zhang

School of Materials Science and Engineering, Beihang University, Beijing, 100191, China

*Corresponding author: Tel: +8610 82316482; E-mail: jialina@buaa.edu.cn

Abstract

The microstructure and room-temperature mechanical properties of directionally solidified and heat-treated Nb-16Si-23Ti-4Cr-2Al-2Hf-0/0.3/0.5Sc (at%) alloys were investigated. All alloys consisted of Nb-based solid solution (Nb_{ss}), α-Nb_5Si_3 and γ-Nb_5Si_3 with preferred <001> orientation for the first two phases, and Sc was enriched in γ-Nb_5Si_3 phase. Sc-added alloys showed a more continuous Nb_{ss} matrix in which the finer Nb_5Si_3 phase distributed uniformly. The volume fraction of both α-Nb_5Si_3 and γ-Nb_5Si_3 phase was decreased by Sc addition. Sc alloying reduced the Young's modulus and nano-hardness of Nb_{ss} phase. 0.50 at% Sc addition enhanced the fracture toughness and tensile strength from 9.88 MPa $m^{1/2}$ and 430.3 MPa to 25.95 MPa $m^{1/2}$ and 1119.7 MPa. The improvement in fracture toughness was due to the better deformability of Nb_{ss} phase. The high tensile strength was attributed to the dispersed and refined Nb_5Si_3 phase, which was not degraded by the increased Nb_{ss} volume fraction since dislocations were not open within most Nb_{ss} phase. Besides, the strong interface cohesion was preferable for the strength of Sc-added alloys.

Keywords: Microstructure; Growth orientation; Young's modulus; Nano-hardness; Fracture