Submitted to 2002 MRS Fall Meeting
Symposium BB: Defect Properties and Related Phenomena in Intermetallic Alloys

Dislocation structure of W-added $NbSi_2$ studied by atomic-resolution Z-contrast STEM

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$NbSi_2$ with the C40-type structure is known to show anomalous strengthening at temperatures around 1370K, and hence it is an attractive candidate for structural applications at high-temperatures. It has been shown that this anomalous strengthening behavior can be improved remarkably by adding a small amount of W to substitute the Nb site [1]. The effect of additional element was discussed in terms of a 'solute dragging' mechanism; W atoms in solution may gather and form an atmosphere around dislocations that resists drag. In the present work, we investigate dislocation structures in the $(Nb_{0.9}W_{0.1})Si_2$ single-crystalline compound, particularly focusing on the local distribution of W around the dislocations. We employ a unique atomic-resolution high-angle annular dark field scanning transmission electron microscope (HAADF-STEM) by which the relatively heavy atom positions emerge out with highlighted-contrast in the image due to the Z(atomic number)-contrast. Preliminary observations along the [0001] direction show that significant Z-contrast occurs at the dislocations; however, energy-dispersive x-ray spectroscopy (EDS) analysis indicates that these Z-contrasts are not due to the enrichment of W atoms, but due to the Nb-enrichment around the dislocation. We also find that very small Nb-rich precipitates (~10nm) are formed at the dislocations. Further details of the dislocation structure focusing on a local chemistry will be described.
[1] Nakano et al., Acta Mater 48 (2000) 3465