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Microstructural Finite Element Analysis of Mo-Si-B Alloy in High Temperature Applications

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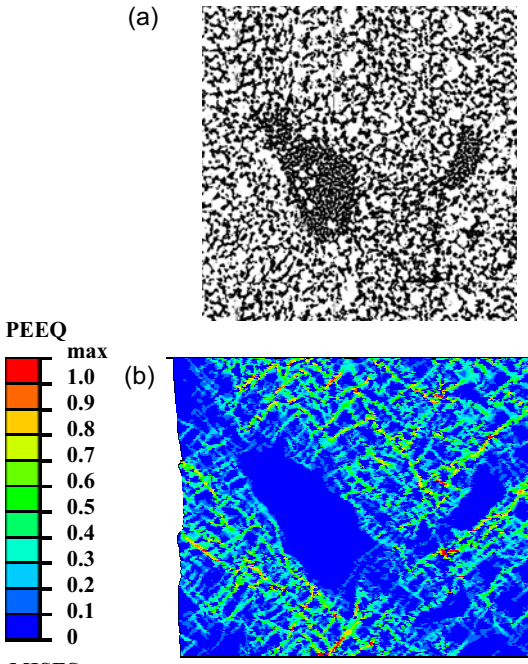

Fig. 1.

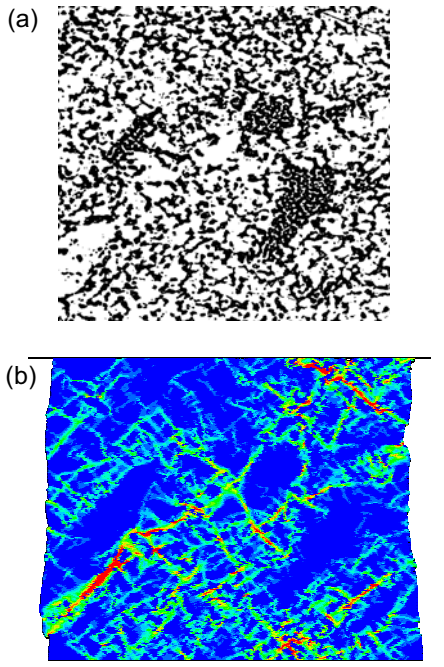

Fig. 2.

The optical micrographs of Mo-Si-B alloys showing two (Fig. 1 (a)) and three (Fig. 2(a)) clusters of T2 (Mo_5SiB_2) phase (shown in black) embedded in Mo solid solution (shown in white) were scanned and digitized into finite element simulation of uniaxial compression. The constitutive relations of both phases were obtained from experimental observation at a temperature of 1000 K and a strain rate of 10^{-3} s^{-1}, where T2 phase only deforms elastically. At maximum compression of 10% engineering strain, the contour plots of plastic equivalent strain (PEEQ) and Mises stress are shown in Fig. 1(b) and Fig. 1(c), respectively, for the case of Fig. 1(a); and Fig. 2(b) and Fig. 2(c), respectively, for the case of Fig. 2(a). The plots show the strain localization in Mo solid solution and stress concentration in elastic T2 clusters due to the inability of T2 clusters to plastically deform. Large T2 clusters also shield off the deformation within the enclosed regions. These numerical findings were well correlated with experimental observation of cracking by the T2 particles in the deformed specimens.* Further uses of this microstructural simulation tool to improve the mechanical properties and/or investigate deformation mechanism are suggested.

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* Alur, A. P., Chollacoop, N. and Kumar, K. S., High-temperature compression behavior of Mo-Si-B alloys Acta Materialia, 52 (2004) 5571-5587.