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Crystallisation of amorphous Fe – Ti – B alloys as a design pathway for nano-structured high modulus steels

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Abstract

We systematically studied the transformation temperatures, type and growth kinetics of phases formed during annealing of Fe – 10.10 Ti – 3.86 B alloys, initially amorphous after rapid solidification. With increasing the temperature, four distinct crystallisation steps could be determined. At 530 °C α-Fe (partly supersaturated with Ti) appeared, and at 600 °C small amounts of not identified phases formed in the amorphous matrix. The matrix fully crystallised to α-Fe and contained (Fe,Ti)-B rich particles at 730 °C, which transformed to the equilibrium TiB_2 phase at 755 °C. During annealing at 1000 °C both α-Fe and TiB_2 exhibited parabolic, apparently diffusion controlled growth at rates of about 2.333 and 0.466 nm $s^{-1/2}$, respectively. Factors influencing the amorphisation as well as strategies for the fabrication of nano-structured high stiffness low density steels via crystallisation from an amorphous precursor state are outlined and discussed.

Keywords: metal matrix composites; metallic glass; steel; titanium diboride; stiffness; density

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