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Tensile property and deformation mechanism of novel γ'-Co_3(Al, W) strengthened Co-Al-W-Mo-Ta-B-Ce alloys

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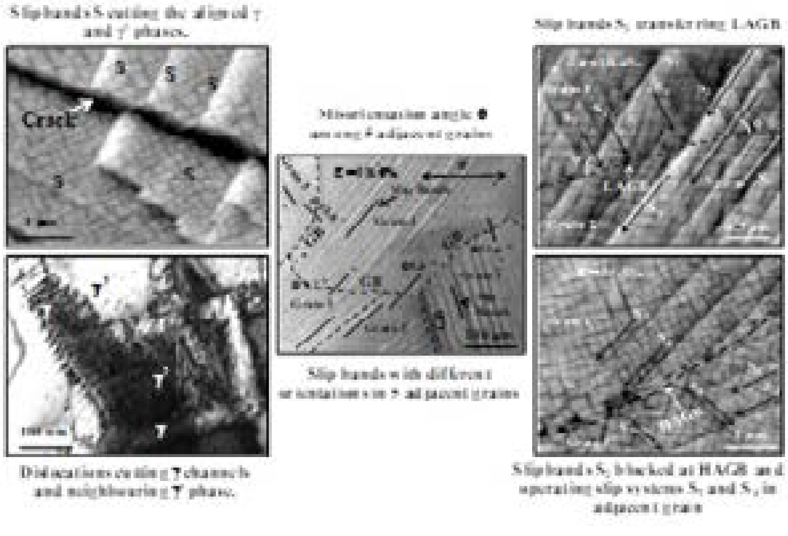
Tensile behaviours and Slip band-grain boundary interactions of γ'-Co_3(Al,W)-strengthened Co-9Al-4.5W-4.5Mo-2Ta-0.02B-(0.01, 0.05, 0.1 and 0.2)Ce alloys (referred to as 0.01Ce, 0.05Ce, 0.1Ce and alloy and 0.2Ce alloys, hereafter) were investigated in-situ using SEM and TEM. Under tension at room temperature, the 0.01Ce and 0.05Ce alloys showing higher strength and elongation fail in a transgranular dimple mode, while the 0.1Ce and 0.2Ce alloys with lower strength and elongation fracture in a mixed transgranular-intergranular mode owing to the Co_3W debond with the grainboundary. The four alloys exhibits tensile flow stress anomalies at temperatures about 700°C. For the 0.01Ce alloy with a γ/γ'-Co_3(Al, W) coherent microstructure, the {1 1 1}<1 1 0> dislocations initiate in the γ channels and subsequently cut into the neighboring γ' phase. A low-angle grain boundary (LAGB) is necessary for the slip band transfer mechanism. The slip bands transfer through the LAGB when the alignment factor M > 0.8 with the incoming easy-slip system and the Schmid factor > 0.3 on the outgoing slip system. The high-angle grain boundaries (HAGBs) usually have a low M value and the incoming slip bands are blocked at the HAGBs without transfer; instead, independent slip systems with the highest Schmid factor in the neighbouring grain are activated. The plastic deformation of the γ/γ'-Co_3(Al,W) microstructure and the slip band-grain boundary interactions lead to elongation larger than 16.4% of the 0.01Ce and 0.05Ce alloys. With some Co_3W precipitates at the grain boundary of the 0.1Ce and 0.2Ce alloys, the slip bands bypass, cut through, or sometimes are arrested by the precipitates, resulting in a low elongation less than 2.1% and a mixed dimple and cleavage failure.



Biography

Jiangbo Sha, received the Ph. D. degree from Xi'an Jiaotong University, Xi'an, China, in 1994. He was a Research Fellow with KNIST and NIMS, Japan, and Nanyang Technological University, Singapore, from 1998 to 2004. He joined the School of Materials Sciences and Engineering Institute, Beihang University, China, as an Associate Professor in 2005, where he has been a Full Professor since 2009. He is interested in novel high-temperature structural materials, such as Nb-Si, and Co-Al-W based alloys, and fatigue behaviours of metallic foils. He found some compositions of these alloys with excellent strength at temperatures from 800 to 1500ºC.

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