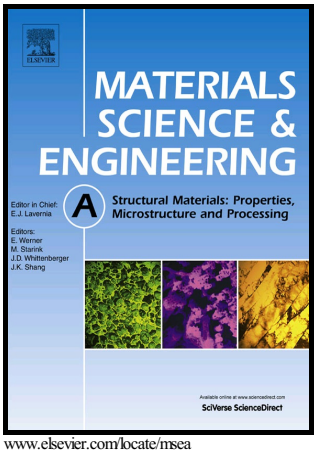

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Mechanism of microstructural refinement of deformed aluminum under synergistic effect of $TiAl_3$ and TiB_2 particles and impact on mechanical properties

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ABSTRACT

To understand the synergistic effect of $TiAl_3$and TiB_2particles on grain refinement of α-Al, equal-channel angular pressing (ECAP) of Al-5Ti-1B (wt. %) alloy was carried out. The ECAPed Al-5Ti-1B (wt. %) alloy was characterized by X-ray Diffraction (XRD), electron backscattered diffraction (EBSD) and transmission electron microscopy (TEM).The results reveal that α-Al grains and $TiAl_3$ phase of ECAPed Al-5Ti-1B (wt. %) alloy were refined, while the average size of $TiB_2$was marginally decreased. The tensile strength was increased from 128 MPa to 218 MPa, and the elongation was reduced from 26% to 20.6%.The transformation from dislocations to low-angle grain boundaries (LAGBs) and high-angle grain boundaries (HAGBs) resulted in continuous dynamic recrystallization (CDRX), which induced grain refinement during ECAP. From 3 to 6 passes of ECAP, CDRX occurred in the alloy, andas ECAP passes increased to 9, the rate of formation of LAGBs and the transformation rate from LAGBs to HAGBs reached a dynamic balance.The present study indicates that the second phase particles promote the formation of LAGBs but prolong complete-recrystallization time, such that complete-recrystallization leads to grain refinement.TiB_2 particles are smaller than $TiAl_3$ particles and this is caused by the composition of the alloy and its synthesis method, and compared with $TiAl_3$, TiB_2 with a smaller size had a more obvious influence on the formation of LAGBs and grain refinement.

Keywords: Al-5Ti-1B (wt. %) alloy; Grain refinement; Second phase particles; Dynamic recrystallization.

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