Combined in situ texture and microstructure analysis of recrystallizing AlZrSc alloy and AlZrSc-TiB2 nano-composite

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Abstract

Texture and microstructure are two important parameters that influence the physical properties of metals and alloys. Having a technique capable to characterize both is therefore important because it helps a better understanding of the effects of thermomechanical processes on the properties of crystalline materials used in industrial applications. The method we used exploits the penetration power of high energy X-rays allowing the measurement of representative volumes. Two detector positions (close and far from the specimen) enable measurements with low and high angular-resolution modes. *i*) *In low resolution mode* a texture measurement is performed based on which the orientation distribution function (ODF) and the volume fraction of main texture components can be calculated. The availability of an area detector and several diffraction rings make texture determination from a highly under-determined problem (typical for laboratory measurements) to an overdetermined one, leading to more accurate results. *ii*) *In high resolution mode*, with the detector at several meters from the sample, high angular resolution peaks were measured for each texture component. Using line profile analysis (LPA) the dislocation density and coherent domain size for each component can be evaluated, which allows determining the heterogeneity of different crystallographic orientations.

In this work we have in situ characterized the change in the volume fraction of 8 texture components of an Al-0.2Sc-0.1Zr alloy and Al-0.2Sc-0.1Zr-5wt%TiB2 nano-composite heated from room temperature to 550∘C at different rates. The results evidence that during heating the volume fraction of different orientation changes differently. Contrary to the changes in texture, the dislocation density in different components decreases at similar rate.

The presented method is particularly useful in practice as it allows the *design* of specific textures and microstructures targeted by industrial applications.

Keywords: Aluminium alloy, texture components, dislocation density, recrystallization

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