Nanoobjects microscopy

Effect of severe plastic deformation on structure and properties of Al-Sc-Ta, Al-Sc-Ti alloys

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The effect of monotonous and non-monotonous severe plastic deformations (SPD) on the structure and properties of aluminum alloys have been studied. A conventional hydrostatic extrusion (HE) with a constant deformation direction and an equal-channel angular hydroextrusion (ECAH) with an abrupt change in the deformation direction were chosen for the cases of monotonous and non-monotonous SPD, respectively. Deformation has occurred at room temperature under the pressure of 150 MPa for HE and 700 MPa for ECAH. *T*otal accumulated strain, *e,* was varied in the 0.77-2.8 range for HE and in the 1.4-6.8 range for ECAH. Model cast hypoeutectic Al-0.3%Sc alloys and hypereutectic Al-0,6%Sc alloys alloyed by Ta and Ti were chosen in the study.

It was demonstrated that SPD of the alloys results in the segregation of the material on active and inactive zones that form a banded structure. The active zones were shown to be bands of localized plastic deformation. The distance between zones was found to be independent of the degree of accumulated strain and was in the range of 0.6-1 μm.

A dynamic recrystallization in the active zones was observed using TEM. The dynamic recrystallization is accompanied by the formation of disclinations, deformation bands, low-angle and high-angle boundaries, i.e. rotational deformation modes are developed. The dynamic recrystallization occurs more intensively during the non-monotonous deformation as compared with the monotonous deformation, which is confirmed by the reduction of both stress and texture degree in materials after ECAH.

The use of ECAH at room temperature for hypoeutectic Al-0,3%Sc alloy allows the formation of supersaturated solid solution without a time-consuming homogenization (640^0C, 10 hours). Yet, the formation of anomalous supersaturated solid solutions in hypereutectic Al-Sc-Ti, Al-Sc-Ta alloys after SPD at room temperature was not achieved.