Functional Materials

LBP.MS.P07
The structure of Fe_3Al intermetallic phase-base alloy after hot plastic deformation

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Keywords: FeAl28 alloys, intermetallic, hot rolling, substructure, dislocation structure

Over the last ten years Department of Materials Science at Silesian University of Technology has conducted research in order to know the structural phenomena which occur during hot plastic treatment aimed at elaboration of heat and plastic treatment technology of selected alloys based on intermetallic phases from the Al-Fe system. Those alloys are classified as a group of high-temperature creep-resisting materials of advantageous physicochemical and mechanical properties at an elevated and high temperatures [1]. Their properties, such as: low density, high melting temperature, high strength and good oxidizing resistance together with good crack resistance, create wide prospects for their industrial applications, for components of machines working at a high temperature and corrosive environment. The major problem restricting their universal application is their low plasticity and their brittle cracking susceptibility. Consequently, the research of intermetallic phase based alloys focuses on their plasticity is required [2-3].

One of the factors responsible for the unfavourable technological properties of Al-Fe alloys is a tendency to coarsely crystalline primary structure. The results indicate that grain refinement by thermo-mechanical processing has positive effect on the improvement in both strength and durability of these alloys. Therefore, the important issue is the evaluation of the behaviour of the material during plastic working. It should be noted that a significant influence on the properties of Al-Fe alloys by thermo-mechanical processing is the presence long-range ordering and the strengthening by thermal vacancy [4-5].

The aim of the paper is a microstructure analysis of alloys from the Al-Fe system after hot rolling tests, conducted by using a scanning transmission electron microscopy STEM and scanning electron microscope equipped with EBSD detector. Hot rolling was carried out at Technical University of Ostrava, Faculty of Metallurgy and Material Engineering, Institute of Modelling and Control of Forming Processes. The samples were heated to a temperature of 1200˚C. The EBSD and STEM techniques have been applied in order to determine the influence of chemical composition and deformation parameters on structural changes. The microstructure analysis has included parameters such us: grain/sub-grain size, area fraction of grains/sub-grains, misorientation angles, grains/sub-grains shape aspect ratio and dislocations structure **(Figure 1).** The research structure techniques in scanning-transmission electron microscopy revealed numerous FeAl28 alloy phase separations of secondary nucleating sites favoured energetically, which are the boundary of grain/subgrain and dislocation structure. These changes in the structure of the test results have been confirmed by EBSD, which revealed the presence of grains/subgrains misorientation angle boundaries above 15°

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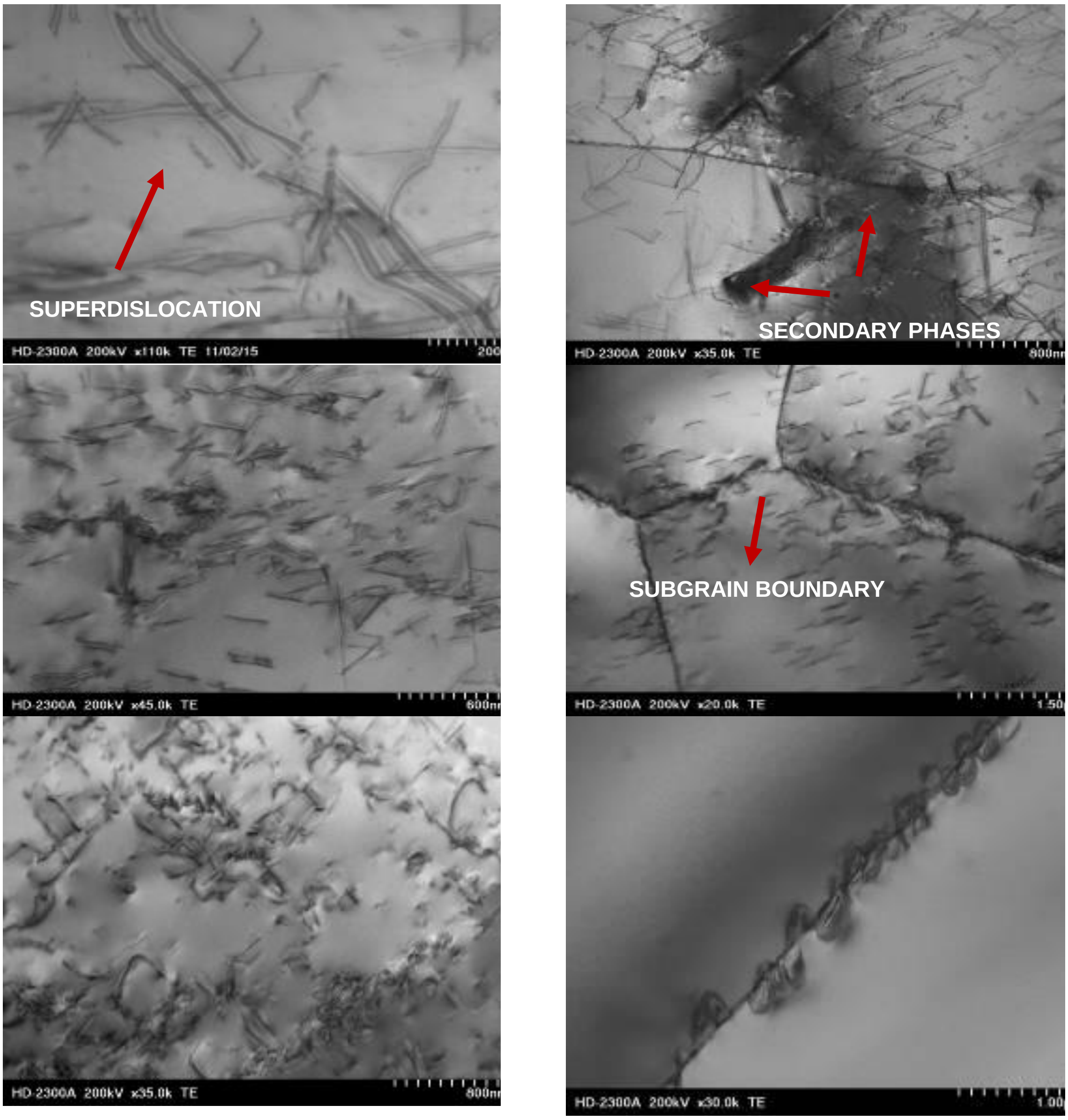
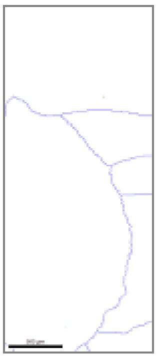


Figure 1. Substructure FeAl28Al alloy after hot rolling

$D_{śr(xy)}$=697µm

a)



b)

Grain boundaries			Fraction
	Angle		
	Min	Max	
	8˚	15˚	0,001
	15˚	180˚	0,085

Figure 2. a) EBSD microstructure map for FeAl28, b) microstructure map of missorientation angles between subgrains/grains

Figure 2b). An average grain diameter/subgrain is $D_{śr(xy)}$=697µm **(Figure 2a).**