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Thermal Stability and Mechanical Properties of 5483 Al Alloy Processed by ECAP

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Equal Channel Angular Pressing (ECAP) is one of the methods which allows to obtain ultrafine-grained and nanocrystalline metallic materials. It is well known that microstructure of materials processed by ECAP in not very stable. There were published many experimental and theoretical evidences of this fact obtained by various methods such as microstructure observations, properties measurement and computer modeling.

The aim of presented paper was to investigate the thermal stability of microstructure and mechanical properties of the Al 5483 alloy processed by ECAP. As a result of performed investigations it was concluded that accumulated plastic deformation has no influence on the thermal stability of Al 5483 alloy processed by ECAP. It was also found that properly chosen parameters of ECAP and subsequent annealing allows to produce materials with high strength and plasticity.

Keywords: ECAP, 5483 Alloy, Mechanical Properties, Thermal Stability.

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1. INTRODUCTION

Equal Channel Angular Pressing (ECAP) is one of the methods which allows to obtain ultrafine-grained and nanocrystalline metallic materials [1,2]. One of the drawbacks of the materials processed by ECAP is their low thermal stability [3,4]. There were published many experimental and theoretical evidences of this fact obtained by various methods such as microstructure observations, microhardness measurements and computer modeling.

The aim of presented paper was to investigate the thermal stability of microstructure and mechanical properties of the Al 5483 alloy processed by ECAP.

2. EXPERIMENTAL

Rectangular samples of 5483 Al alloy processed by ECAP in an L-shaped, 90 °channel at 180 °C using route Bc were used for investigations. For the aim of the investigations there were performed standard tests, such as micro-hardness measurements, microstructure observations and tensile tests of non-standard micro-specimens cut-out from various parts of the samples processed by ECAP. The investigation was carried out for samples subjected to 1, 4 and 8 passes of ECAP.

3. RESULTS AND DISCUSSION

Microstructure of 5483 alloy specimens after equal channel angular pressing and annealing at a temperature range 265-350 °C is shown in Fig. 1. It is visible that grain growth occurred faster in the samples after 1 ECAP pass than after 8 passes.

It was found that mechanical properties (microhardness, yield strength, tensile strength and elongation to rupture) are stable up to about 250 °C. It shown in Figures 2-6. It was also found that annealing in the temperature range 250-300 °C results in the strong changes of grain size and mechanical properties. At the higher temperatures (300-350 °C) stabilizations of mechanical properties was observed.

Materials annealed in the temperature range 265 ÷ 350 °C had higher yield strength, tensile strength and elongation to failure than the material in the initial state. Such experimental observations allows to conclude that ECAP processing and subsequent annealing can be a way of improvement both: strength and plasticity of metallic materials.

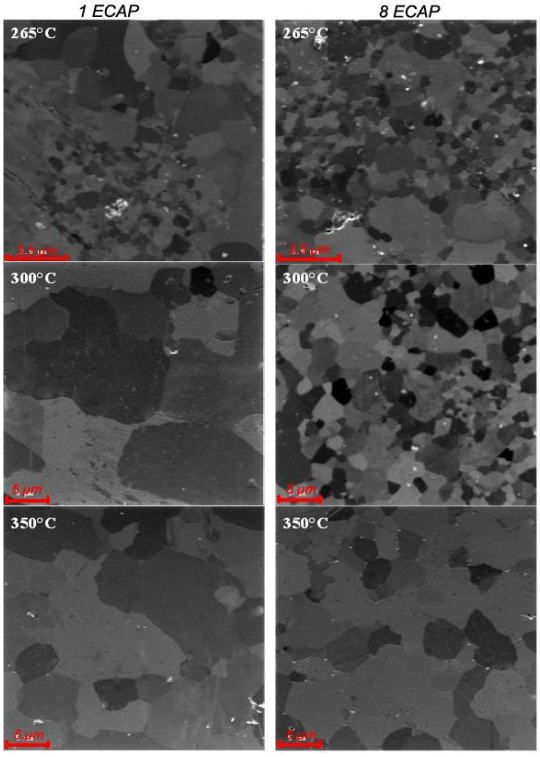

Fig. 1 - Microstructure of 5483 alloy processed by ECAP and annealed

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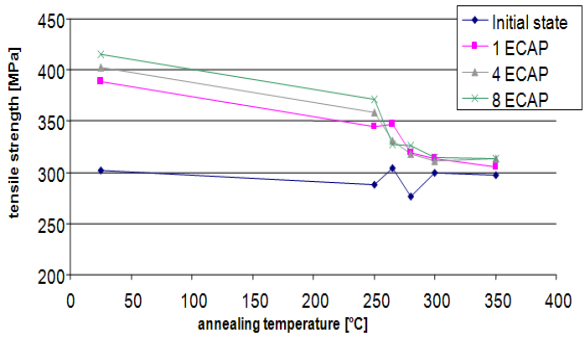

Fig. 2 - Tensile strength of 5483 alloy processed by ECAP in a function of annealing temperature

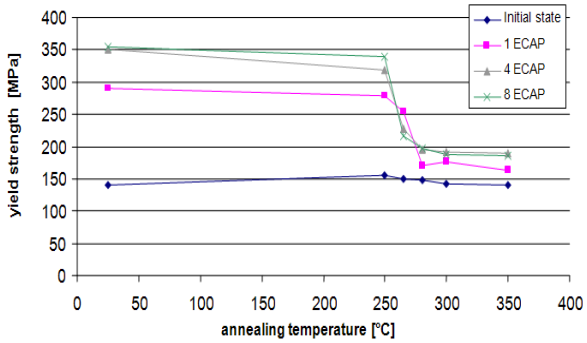

Fig. 3 - Yield strength of 5483 alloy in a function of annealing temperature

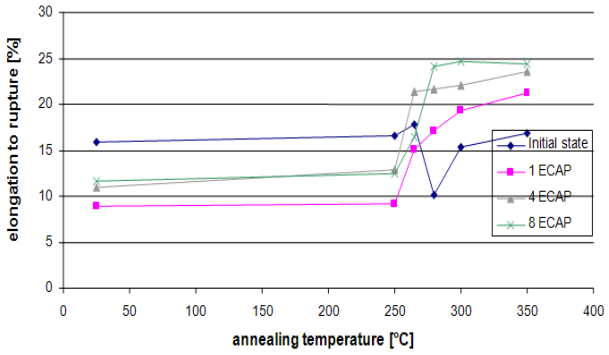

Fig. 4 - Elongation to rupture of 5483 alloy processed by ECAP in a function of annealing temperature

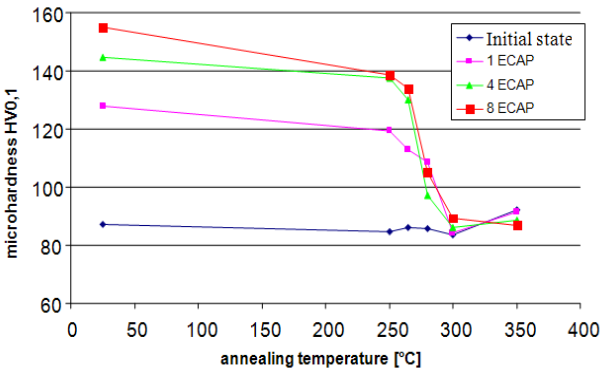

Fig. 5 - Microhardness of 5483 alloy processed by ECAP in a function of annealing temperature

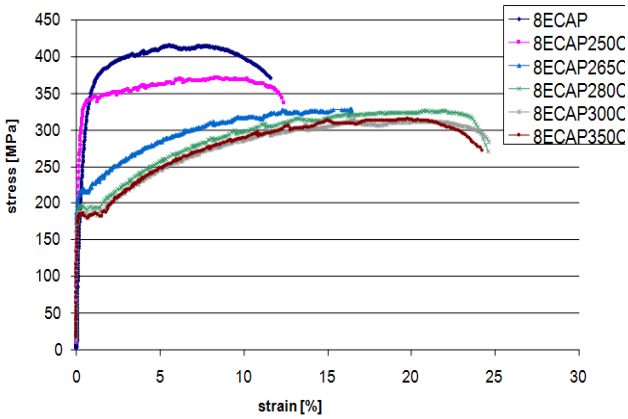

Fig. 6 - Stress-strain curves of aluminium 5483 alloy after 8 ECAP passes and annealing

4. CONCUSIONS

Accumulated plastic deformation has no influence on the thermal stability of Al 5483 alloy processed by ECAP.

Properly chosen parameters of ECAP and subsequent annealing allows to produce materials with high strength and plasticity.

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