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비대칭 압연한 AA 3003 합금의 조직 변화

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Texture of Asymmetrically Rolled AA 3003 Aluminum alloy

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Abstract

The effect of asymmetric rolling on the recrystallization texture of an AA 3003 Aluminum alloy was investigated by X-ray diffraction. It was found that the texture of asymmetrically rolled sheets prior to subsequent heat treatment promoted the formation of the <111> // ND textures, and remained after heat treatment at 275°C during 20 min in salt bath condition.

Key Words: Aluminum sheet, Shear Deformation, Texture, Cold rolling

1. Introduction

Optimization of the drawability of the shear deformed metals and alloys is in high demand. With shear deformation processes can be obtained very fine grained materials with high strength but limited formability properties. In order to improve drawability and the lower planar anisotropy of AA 3003 Aluminum Alloy sheets, asymmetric rolling process were investigated in this study.

It has been found that the deformation in metals sheets of <111> plane parallel to the sheet surface helps to increase the r-value and variation of the textures decreasing Δr-values. However, due to the high energy stored in the deformed state and the existence of structural heterogeneities, annealing conditions are critical and unwanted structures may form [1–6].

In the present paper investigation the AA 3003 Al sheet was cold rolled without lubricant to investigate the effects of the severe shear deformation on texture and plastic strain ratio of subsequent heat treated AA 3003 Al sheet.

2. Experimental

Sheet of commercial AA3003 aluminum alloy was used to obtain a severe deformation by asymmetric rolling process. The sheet samples, with dimensions of 60mm x 40mm x 3mm, were prepared from a sheet along the rolling direction. Then these plates were annealed at 500° C for 1 hour to homogenize the initial grain size through thickness (named initial Al sheet). The annealed Al sheets were then asymmetrically rolled to 80% reduction in thickness on a laboratory asymmetrical rolling mill with roll ratio 1.5. To obtain high friction ratio no lubricant was used during rolling process. After the asymmetrical rolling, to study the texture development of the asymmetrical rolled Al sheets, samples were heat treated at the temperature of 275°C for 20 min in salt bath condition.

The texture change of the asymmetrically rolled and heat-treated samples, the incomplete pole figures of (111), (200), and (220) for each sample were measured by using X-ray goniometer. Texture measurements were performed at half thickness of the asymmetrically rolled sheets.[7]

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3. Experimental results and discussions

Fig.1 shows (111), (200) and (220) pole figures cutouts of center layer of AA3003 aluminum alloy sheet: (a) initial Al sheet, (b) 80% asymmetrically rolled, (c) 80% asymmetrically rolled and subsequent heat treated at 275°C for 20 min.

{001}<100> cube component is observed at center layer in initial Al sheet of Fig. 1 (a). With asymmetric cold rolling to the 80% reduction in thickness, {001}<100> cube component is disappeared in Fig. 1 (b), and the <111>//ND texture observed after 80% reduction on thickness during the asymmetric rolling without lubricant of AA 3003 aluminum alloy sheets. The <111>//ND texture on the center layer did not distorted and a little moved close to the normal direction after the subsequent heat treatment at 275°C during 20min. in salt bath.

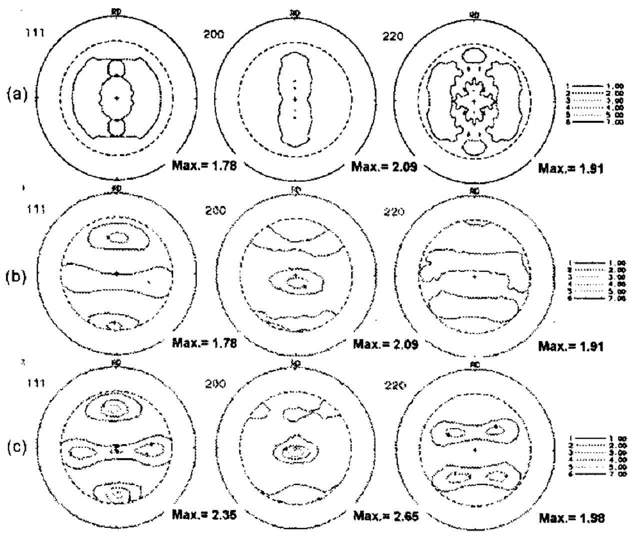

Fig.1 (111), (200) and (220) pole figures cutouts from center layer of AA 3003 aluminum alloy sheet: (a) initial Al sheet, (b) 80% asymmetrically rolled, (c) 80% asymmetrically rolled and subsequent heat treated at 275°C for 20 min.

4. Summary

After asymmetric rolling and <111>//ND texture components was observed on the center layer of thickness AA 3003 Aluminum alloy sheets. This texture did not distorted after subsequent heat treatment during 275C during 20 min in salt bath condition.

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