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비대칭 압연 알루미늄의 소성변형비

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Plastic Strain Ratios of Asymmetry Rolled Aluminum Sheets

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Abstract

The physical and mechanical properties of the sheets metals are closely related to the presence of preferred crystallographic orientations which were produced by the manufacturing process. To obtain the aluminum alloys sheets with good Al sheet formability, the plastic strain ratio (or r-value) of AA1050 Al sheets after asymmetric rolling and subsequent heat treatment was studied. The AA1050 aluminum alloy sheets after asymmetric rolling with high reduction ratio and following heat treatment had the higher plastic strain ratio.

Key Words: Aluminum sheet, Shear Deformation, Texture, Cold rolling, Plastic strain ratio, Formability, Plastic Strain Ratio, Asymmetric Rolling.

1. Introduction

Many researchers are interested in the increasing of the formability of the shear deformed metals and alloys. Using shear deformation processes can be obtained very fine grained materials with high strength but limited formability properties.

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 [1–5]. In the present paper, the AA1050 Al sheet was asymmetrically rolled with high reduction ratio without lubricant, investigated the effects on plastic strain ratio of the asymmetric rolled and subsequent heat treatment of AA1050 Al sheet.

2. Exprimental

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Sheet of commercial AA1050 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 different reductions ranging from 0 to 80% on a laboratory asymmetrical rolling mill with roll ratio1.5. Hence we will observe only 80% cold rolled samples. To obtain high friction ratio no lubricant was used during rolling process. After the asymmetrical rolling, to study the formability of the asymmetrical rolled Al sheets, samples were annealed at the temperature of 300°C and 400°C for 1 hour in an air condition. It was tensile tested to obtain the r-value along the angles of 0°, 45°, 90° to rolling direction. Fig.1. shows schematically drawing of tensile specimens for r-value measurements. The average r-value ($\bar{r}$ -value), and Δr-value was obtained from the measured and calculated r-value data. The average measured r-value ($\bar{r}$ -value) was calculated by the use of $\bar{r} = (r_0 + 2r_{45} + r_{90}) / 4$, and Δr-value was calculated by the use of $\Delta r = (r_0 - 2r_{45} + r_{90}) / 2$. Here, the $r_{0, 45}$, and r_{90} mean the r-value of along the angles of 0°, 45°, and 90° to rolling direction, respectively.

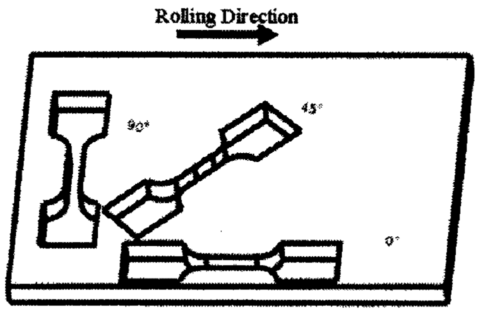

Fig. 1 Schematic drawing of tensile specimens for plastic strain ratio measurements

3. Results and Discussion

Table 1 shows also the variation of average r-value ($\bar{r}$-value), and Δr-value that obtained from the measured r-value data. The average r-values of the 80% asymmetrical rolled and subsequent heat-treated at 300°C and 400°C/1hour Al sheet measured data is higher than that of the initial specimen. The average r-values of the asymmetrically rolled measured Al sheet are higher than that of the initial Al sheet.

Table 1. The Comparison of measured r-value, $\bar{r}$, and $|\Delta r|$ of the 80% asymmetric cold rolled Al sheet data.

Conditions of samples	r-value			$\bar{r}$	$\|\Delta r\|$
	0°	45°	90°		
Initial specimen (500°C/1 hr)	0.38	0.521	0.403	0.326	-0.129
80% asymmetrical rolled (300°C/1 hr)	0.65	1.14	0.766	0.924	-0.432
80% asymmetrical rolled (400°C/1 hr)	0.584	0.94	0.62	0.771	-0.338

4. Conclusion

The average Plastic strain ratios (r-values) of the asymmetric cold rolled with measured Al sheet is higher than that of the initial Al sheet.

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