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마찰 압연한 AA 3003 합금의 조직 변화

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Texture of Frictionally Rolled AA 3003 Aluminum alloy

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Abstract

The effect of frictional rolling and subsequent heat treatment was studied on the evolution of texture of AA 3003 Aluminum alloy. With frictional rolling without lubrication it is possible to obtain a larger friction between roll and sample which lead to the formation of uniform rolling texture in the whole thickness layers.

Key Words: Aluminum sheet, Shear Deformation, Texture, Cold rolling, Plastic strain ratio, Formability, r-value

1. Introduction

Severe deformation is a powerful tool in designing preferred orientations with improved properties. During last decades, various techniques have been used to produce fine grain sizes in materials. Rolling is a well-known industrial process which is frequently applied in the processing of sheet metals and alloys. Frictional rolling was applied to produce fine grains from an initial AA 3003 Aluminum alloy sheet to determine whether it is possible to get <111> plane parallel to the sheet surface and increase formability properties.

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].

2. Experimental

Sheet of commercial AA3003 aluminum alloy was used to obtain a severe deformation by frictional 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 frictionally rolled to different reductions ranging from 0 to 90% on a laboratory rolling mill. Hence we will observe only 90% cold rolled samples. To obtain high friction ratio no lubricant was used during rolling process. After the frictional rolling, to study the formability of the asymmetrical rolled Al sheets, samples were heat treated at the temperature of 500°C for 1 hour in air condition.

The texture change of the frictionally rolled and subsequent 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 center layer of the frictionally rolled sheets.[9]

3. Experimental results and discussions

Fig.1 shows (111), (200) and (220) pole figures of center layer of AA 3003 aluminum alloy sheet: (a) initial Al sheet, (b) 90% frictionally rolled, (c) 90% frictionally rolled and subsequent heat treated at 500°C for 1hour.

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With frictionally cold rolling to the 90% reduction in thickness, initial texture is distorted in Fig. 1 (b), and the β-fiber component on the center layer is a little moved close to the normal direction after the frictionally rolling without lubricant of AA 3003 aluminum alloy sheets in Fig. 1 (b). This moving of β fiber component is obtained by the result of shear deformation during frictionally rolling process in Fig. 1 (b). The β fiber component on the one center layer is disappeared after frictionally rolled and subsequent heat treated at 500°C for 1hour in Fig.1 (c).

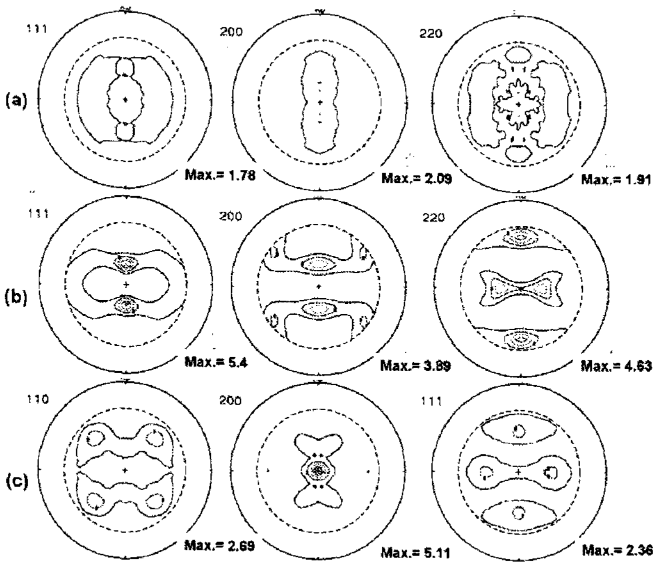

Fig.1 shows (111), (200) and (220) pole figures of center layer of frictionally rolled AA 3003 aluminum alloy sheet: (a) initial Al sheet, (b) 90% frictionally rolled, (c) 90% frictionally rolled and subsequent heat treated at 500°C for 1hour.

4. Summary

The β fiber component on the one tenth thickness surface layer is moved close to the normal direction about 5 degrees after the frictionally rolling without lubricant of AA 3003 aluminum alloy sheets.

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References

1. [1] PH. Lequeu and J. J. Jonas: Metal. Trans. A, Vol. 19A (1988), p. 105
2. [2] H.-D. Kim, M.-Y Huh, N.-J. Park, and Y.H. Chung, Met. Mater. Int. Vol. 9 (2003), P. 413
3. [3] Y. Saito, H. Utsunomiya, H. Suzuki and T. Sakai, Scripta Mater. Vol. 42 (2000), p. 1139
4. [4] S. Akramov, M.G. Lee, I. Kim, D.Y. Sung, B.H. Park, and I. Kim, Mater. Sci. Forum Vol. 495-497 (2005), p. 803
5. [5] K.J. Kim, H.-T. Jeong, K.S. Shin, and C.-W. Kim, J. Mater. Process. Tech. (2007), in press
6. [6] M. Hatherly, and W.B. Hutchinson: An Introduction to Textures in Metals, (Institution of Metallurgists, London, 1979)
7. [7] J. Hirsch, and K. Lucke, Acta Metall. Vol. 36 (1988) p. 2883
8. [8] A.K. Vasudevan, and R.D. Doherty, Aluminum Alloys-Contemporary Research and Applications, Treatise on Materials Science and Technology, Vol. 31, Academic Press, 1989
9. [9] H.J. Bunge: Texture Analysis in Materials Science Mathematical Methods, translated by P.R. Morris (Butterworths, London, 1982)