THE RELATIONSHIPS BETWEEN GLOBAL AND EVERY LAYER DEFORMATION TEXTURES OF 70-30 BRASS ROLLED BY CROSS SHEAR ROLLING①

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ABSTRACT Global and every layer deformation textures were described and the relationship between them were investigated by three dimensional orientation distribution function. It was found that the macroscopic statistical unsymmetry of global texture is not the same as that of every layer texture, but consistent with that of beside slow speed roller, the results which were added and averaged by 5 layers ODF do not represent global texture.

Key words: cross shear rolling macroscopic statistical unsymmetry texture three dimensional orientation distribution function(ODF)

1 INTRODUCTION

The unsymmetric plastic flow produced by cross shear rolling in single directon results in macroscopic statistical unsymmetries of texture in global and every layer[1-2], this kind of unsymmetry can lead directly the change of rolled plate property, therefore, it is important to research the macroscopic statistial unsymmetries of texture.

In this paper, the unsymmetries of texture in global and every layer of 70-30 brass rolled by cross shear rolling in single direction are discribed and the relation betwen global and every layer textures is investigated by the three dimentional orientation distribution function(ODF).

2 EXPERIMENTAL

Commercial 70-30 brass 2 mm in thickness was rolled by cross shear rolling in single direction at 90% reduction in thickness, linear velocities ratio of fast and slow speed rollers was 1. 28. Then the rolled plate was divided into five layers along rolling plane normal, from surface beside slow roller, each layer was marked by 0, 1/4, 1/2, 3/4, 1 layer respectively. Several pieces of tested sheets were glued together in accordance with same rolling direction to form a rectangle body in which a section was cut and an arrow was signed in the section as in measured composite sample {111}, {200}and{220} three imcomplete pole figures are measured by the Schulz method[3], $20° \leqslant \alpha \leqslant 90°$, $\Delta\alpha = \Delta\beta = 5°$. The unsymmetric ODFs were calculated as $L_{max} = 16$[4].

Under the coordinate OA'B'C' of the composite sample, the coefficient of ODF is W_{lpn}' which can be transformed into the coordinate OABC in which RD, TD and ND are characteristic direction according to formula[5]

$$W_{lmn} = \left(\frac{2}{2l+1}\right)^{1/2} \sum_{p=-l}^{l} Z_{lpm}(\cos\beta) \times e^{-ip n} e^{im\gamma} W_{lpn}' \quad (1)$$

where α, β and γ is Euler angle. ODF can be calculated by means of W_{lmn}.

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3 RESULTS

The ODF sections of costant $\Psi = 35°$ and $\Psi = 145°$ in every layer and global of 70-30 brass rolled by cross shear rolling in single direction are shown in Fig. 1. It is found that main textures in every layer and global are {110}<112> which are the same as main texture of 70-30 brass rolled by common rolling,

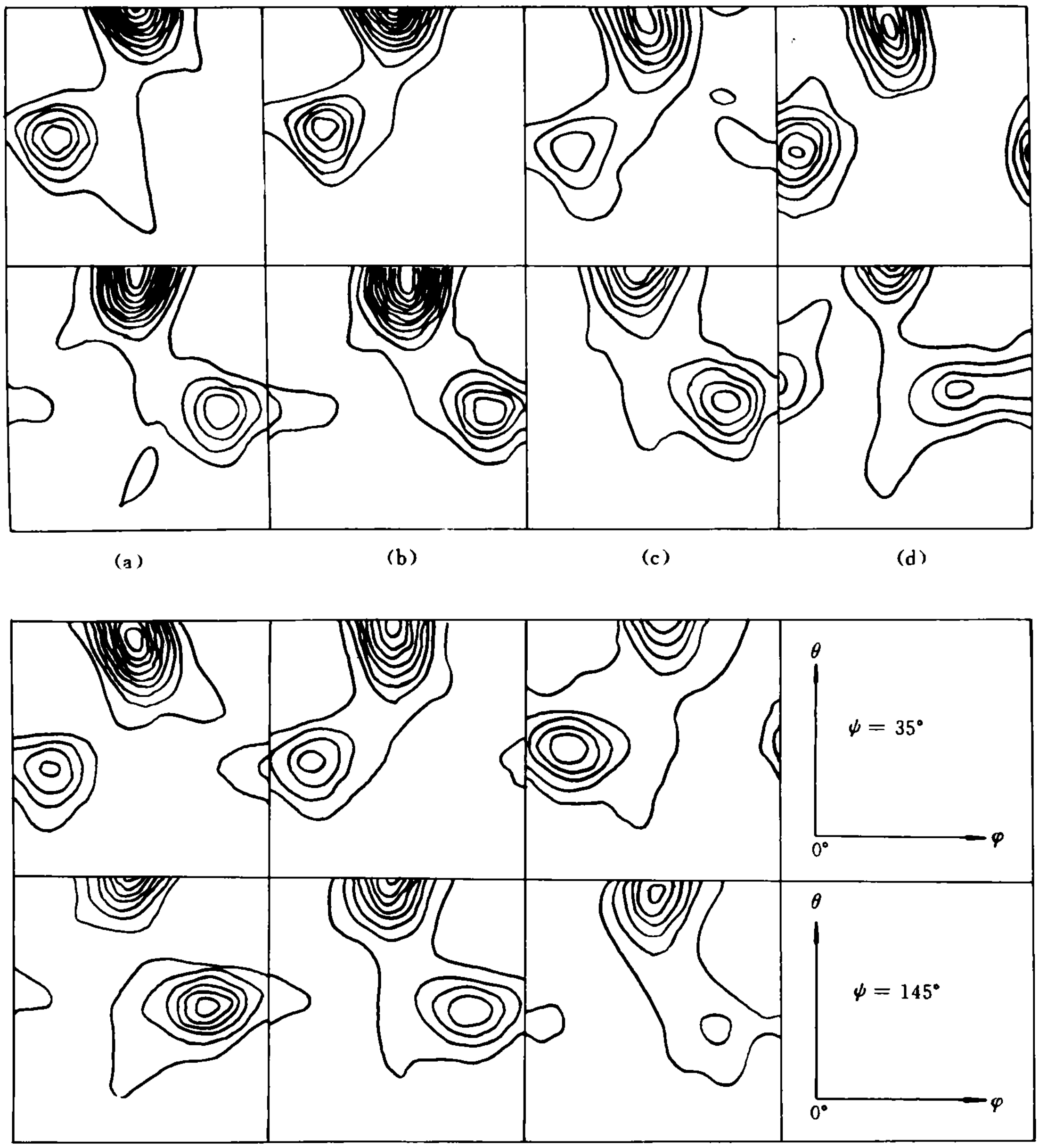

Fig. 1 **$\Psi = 35°$ and $\Psi = 145°$ ODF costant sections of every layer and global textures**
(a)—0 layer; (b)—1/4 layer; (c)—1/2 layer; (d)—3/4 layer;
(e)—1 layer; (f)—average of 5 layers; (g)—global

but the intensity and scattering of every texture component in {110}<112> are different, that is, there is a macroscopic statistical unsymmetry. In 0, 1/4 and 1/2 layers, intensity of $(\bar{1}10)[\bar{1}\bar{1}2]$ is weaker than that of $(\bar{1}10)[112]$, in 3/4 and 1 layers, intensity of $(\bar{1}10)[\bar{1}\bar{1}2]$ is stronger than that of $(\bar{1}10)[112]$, it is just contrary with the condition in 1, 1/4 and 1/2 layers. Simulatneously, the unsymmetry of texture beside fast roller is stronger than that beside slow roller.

The result added and averaged from ODFs of five layers shows that intensity of $(\bar{1}10))[\bar{1}\bar{1}2]$ is stronger than that of $(\bar{1}10)[112]$ and there still is weaker macroscopic statistical unsymmetry.

ODF section (Fig. 1(g)) calculated from composite sample reveals a macroscopic statistical unsymmetry of global texture, that is intensity of $(\bar{1}10)[\bar{1}\bar{1}2]$ is weaker than that of $(\bar{1}10)[112]$ and the unsymmetry is stronger but intensity of texture is weaker.

4 DISCUSSION

In the cross shear rolling, the unsymmetry of linear velocities between the fast and slow speed rollers forms the cross shear rolling zone (Fig. 2) in which shear forces to the exit and the entrance direction respectively produced on the sheet beside fast and slow rollers, therefore, unsymmetric plastic flow and macroscopic statistical unsymmetry of texture are formed . In backward slip zone

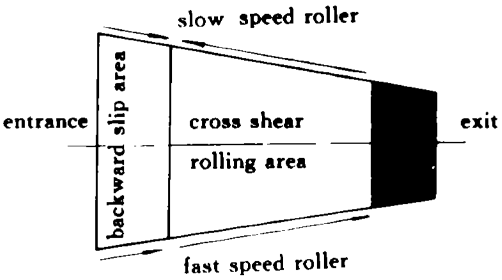

Fig. 2 Shear force state in cross shear rolling area

there are the shear forces to exit direction on the sheet beside fast and slow rollers, they can separately increase and decrease unsymmetric plastic flows and the symmetry of texture on the fast and slow rollers. Inside of the sheet, different shear forces which are weaker than that of surfaces are produced and result in weaker intensity and the unsymmetry of texture.

Through the unsymmetry in 1 layer is the strongest, but the texture beside the slow roller is stroger and the unsymmetry in center layer is the same as the unsymmetries in 0 and 1/4 layers, therefore, macroscopic statistical unsymmetry of global texture is identical with the unsymmetries in 0, 1/4 and 1/2 layers. Because of the cracks among every pieces on the section measured in composite sample, the intensity of global texture is weaker than that of every layer.

The unsymmetry of texture which is added and averaged by 5 layers is weaker and is consitent with the unsymmetry of texture beside the fast roller, it can not represent the unsymmetry of global texture.

5 CONCLUSIONS

(1) Macroscopic statistical unsymmetry of global texture is not the same as that of every layer texture, the unsymmetry of global texture is identical with that beside slow speed roller.

(2) The results which are added and averaged by 5 layers ODF do not represent global texture.

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