PRIMARY RECRYSTALLIZATION TEXTURES OF 70-30 BRASS ROLLED BY CROSS SHEAR ROLLING IN SINGLE DIRECTION①

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ABSTRACT

The primary recrystallization textures of 70-30 brass rolled at 90% reduction in thickness by cross shear rolling in single direction with 1.39 speed ratio were calculated by three dimensional orientation distribution function. It is found that the main textures of every laryer along rolling plane normal are the same as that of 70-30 brass rolled by conventional rolling, but the intensites and scatters of every texture component in main texture are different. The macroscopic statistical unsymmetry of deformation textures were carried out very well by primary recrystallization textures in process of primary recrystallization, nucleation occupies a dominant position.

Key words: cross shear rolling recrystallization texture macroscopic statistical unsymmetry three dimensional orientation distribution function

1 INTRODUCTION

In the process of cross shear rolling, plastic flow of metal sheet is unsymmetric which leads to macroscopic statistical unsymmetry in rolling and recrystallization textures. This phenomenon was researched[1-3], but little study had been done on the macroscopic statistical unsymmetry of primary crystallization textures in 70-30 brass. In this paper, primary crystallization textures in every layer of 70-30 brass rolled by cross shear rolling in single direction are described and analysed by means of the three dimensional orientation distribution function (ODF). Furthermore, transformation mechanism of primary recrystallization texture with macroscopic statistical unsymmetry from deformation texture are investigated in detail.

2 EXPERIMENTAL

Commercial 70-30 brass at 2 mm thinkness has been rolled with 90% reduction by cross shear rolling in single direction, the speed ratio is 1.39. At 340℃, the sample is annealed in salt bath. Then, it is divided into 5 layers along rolling sheet normal which marked by 0, 1/4, 1/2, 3/4 and 1 layer respectively.

Three incomplete pole figures are measured by Schulz method, $20° \leqslant \alpha \leqslant 90°$, $\Delta\alpha = \Delta\beta = 5°$, after that unsymmetric ODFs are calculated, $L_{max} = 16$[4].

3 RESULTS

The ODF section figures at $\varphi = 20°$ and $\varphi = 70°$ in 0, 1/4, 1/2, 3/4 and 1 layers of the primary recrystallization brass rolled by cross shear rolling in single direction are shown in Fig. 1. It is found that the main texture in every layer is {236}⟨385⟩, which is the same as the main texture of common rolling[5], but the intensities of {236}⟨385⟩ in every layer are not identical, namely, there is distinct macroscopic statistical unsymmetry. In 0 layer, the intensity of $(\bar{6}32)[5\bar{8}3]$ is weaker than that of $(\bar{3}62)[\overline{853}]$, in 1 layer, it is opposite to the unsymmetry in 0 layer, the unsym-

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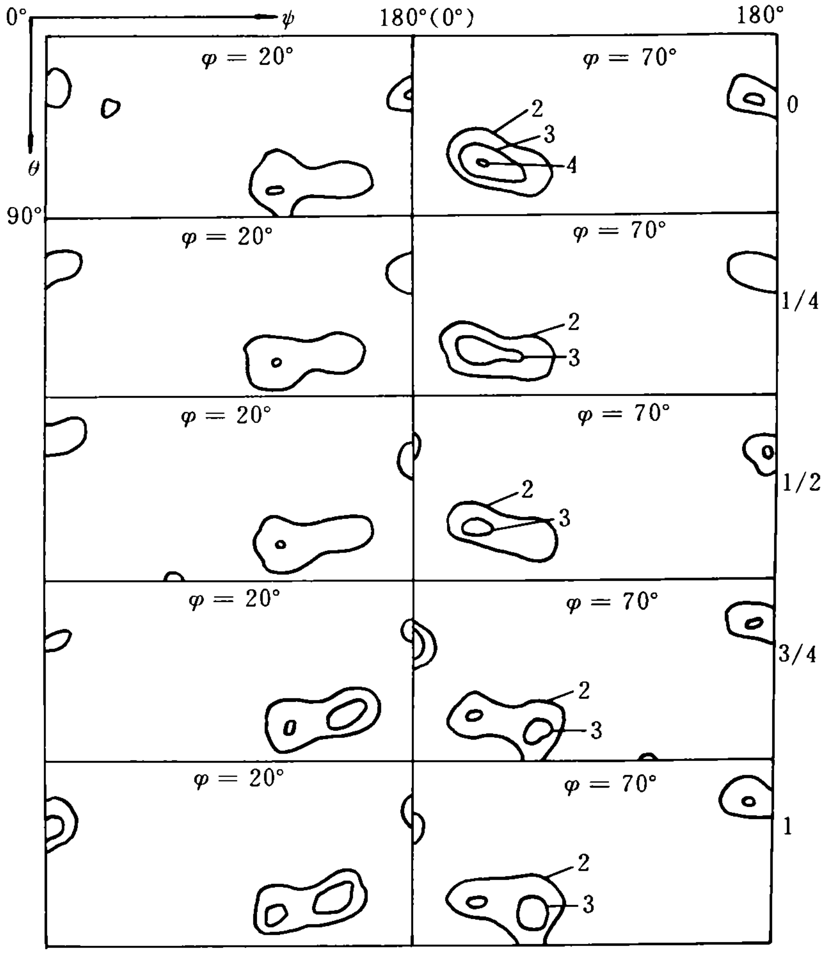

Fig. 1 ODF constant $\varphi = 20°$ and $\varphi = 70°$ section figures

metries in 1/2 layer(including 1/4 layer) and 3/4 layer are respectively similar to that in 0 layer and 1 layer. The changes of textural intensities(Fig. 2) show that the intensity of $(\bar{6}32)[\bar{5}\bar{8}3]$ increases, but intensity of $(\bar{3}62)[\bar{8}\bar{5}3]$ decreases with change from 0 layer to 1 layer, the position where two textural intensities are equal is between 1/2 layer and 3/4 layer.

4 DISCUSSION

Hu and cooperators pointed out that the primary recrystallization main texture of 70-30 brass rolled by common rolling is {236}⟨385⟩, which was considered as a result got from the deformation main texture {110}⟨112⟩ turning round ⟨111⟩ axis[6]. For common rolling, because intensities of every texture component in the deformation main

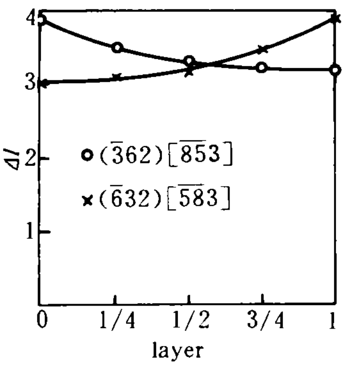

Fig. 2 Changes of $(\bar{6}32)[\bar{5}\bar{8}3]$ and $(\bar{3}62)[\bar{8}\bar{5}3]$ intensites with layers

texture {110}⟨112⟩ are the same, intensities of every texture in the primary recrystallization main texture {236}⟨385⟩ are the same too. For cross shear rolling in single direction, intensities of every texture in the deformation texture {110}⟨112⟩ are different(Fig. 3)[2]. According to the transformed relation mentioned above, the authors infer that intensities of every texture in the primary recrystallization main texture {236}⟨385⟩ are different too. In 0 layer, intensity of $(\bar{1}10)[\bar{1}\bar{1}2]$ is higher than that of $(\bar{1}10)[\overline{112}]$. Therefore, intensity of $(\bar{3}62)[\bar{8}\bar{5}3]$ is higher than that of $(\bar{6}32)[\overline{583}]$; in 1 layer, because intensity of $(\bar{1}10)[\bar{1}\bar{1}2]$ is weaker than that of $(\bar{1}10)[\overline{112}]$, intensity of $(\bar{3}62)[\bar{8}\bar{5}3]$ is weaker than that of $(\bar{6}32)[\overline{583}]$ too. The experimenal results verify these analyses.

From 0 layer to 1 layer, the difference between $(\bar{1}10)[\bar{1}\bar{1}2]$ and $(\bar{1}10)[\overline{112}]$ intensities from positive to negative, the position in which $(\bar{1}10)[\bar{1}\bar{1}2]$ intensity equals to $(\bar{1}10)[\overline{112}]$ intensity is between 1/2 layer and 3/4 layer (Fig. 4 (a)), the change tendency of the difference between $(\bar{3}62)[\bar{8}\bar{5}3]$ and $(\bar{6}32)[\overline{583}]$ intensities from 0 layer to 1 layer is the same as that between $(\bar{1}10)[\bar{1}\bar{1}2]$ and $(\bar{1}10)[\overline{112}]$ intensities (Fig. 4 (b)). This conforms to experimental result.

According to the analyses and results mentioned above, the unsymmetry of the deformation

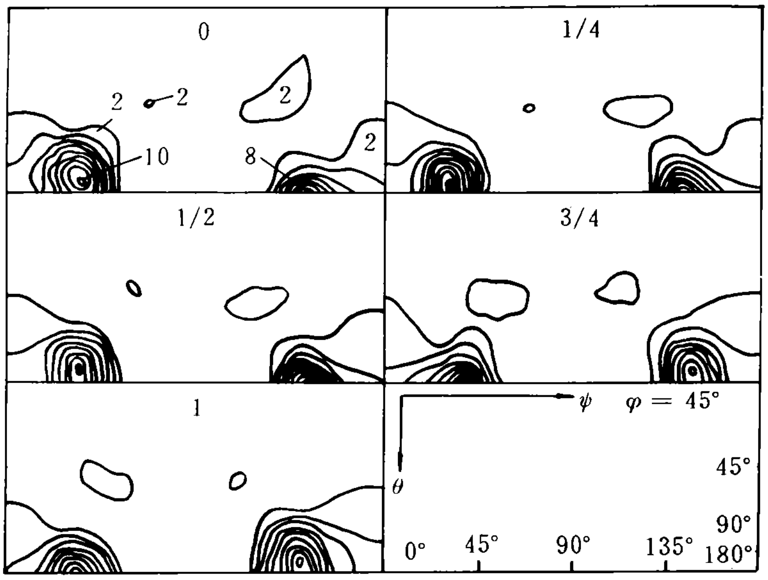

Fig. 3 ODF constant section figures of deformation texture in every layer
($\varphi = 45°$)

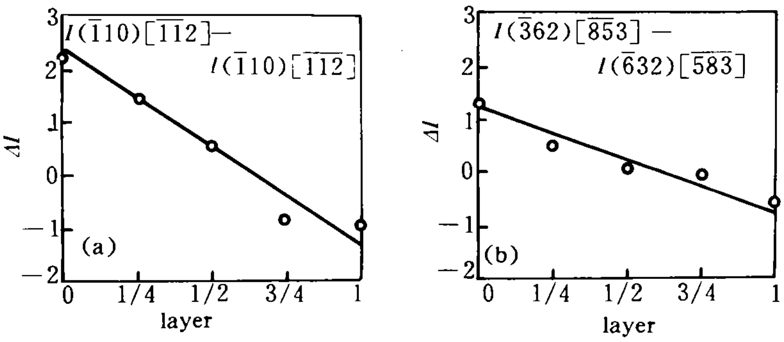

Fig. 4 Changes of intensity difference with layers
(a)—Deformation textures; (b)—Primary recrystallization textures

texture corresponds with that of the primary recrystallization texture, the primary recrystallization texture inherits the unsymmetry in deformation texture. This fact illustrates that the primary recrystallization almost produces in every layer at same time. Otherwise, the unsymmetry will not exist. It is deduced that nucleation occupies a dominant position in the primary recrystallization.

5 CONCLUSIONS

(1) The main texture in every layer in primary recrystallization texture of 70-30 brass rolled by cross shear rolling in single direction is {236}⟨385⟩ yet, but the intensities of every texture in {236}⟨385⟩ are not the same, namely there is a macroscopic statistical unsymmetry.

(2) The primary recrystallization in every layer inherits the unsymmetry of deformation texture in corresponding layer.

(3) Nucleation occupies a dominant position in the primary recrystallization.

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(*From page 104*) skeleton. The materials with biodegradating function and introducing bone formation function will be used to fill the vacancies in which cancers have been scraped over. The author recommends that the composites of HA and TCP which have atom ratio of Ca to P being equal to 1.50～1.67, seeing the dotted line part in Fig. 4, are good for some other surgical situations attributing to both their biodegradation and bio-mechanical compatibility. The author's works[9] have confirmed the above views.

4 CONCLUSIONS

Calcium-phosphate biomaterials with phase structure closely similar to that of hard tissue of human bone and dent can be yielded by sol- gel method. The present research has testified that the effects of the pH values of sol-gel solutions and firing and/or sintering temperature on phase transformation are remarkable. XRD and TG-DTA show that phase transformation takes place at 789 ℃ in powder B which comes from the sol- gel solution with lower level pH value, and more HA structure transforms into TCP structure in powder B while fired at 1 100 ℃. There is no phase transformation in powder A which comes from the sol-gel solution with higher level pH value until 1 100 ℃. Usually the higher the firing (sintering) temperature, the more the TCP structure in both powder A and powder B.

Animal implanting tests expressed that a firm bone-bond can be formed between HA, TCP and natural hard tissues in a short time and biomechanical compatibility of HA material is superior to that of TCP with lasting implanting time.

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