Anisotropy of substructure in secondary recrystallized grain in 3%Si-Fe

Yoshiyuki Ushigami*[1], Shuich Nakamura1[1],Noriaki Ota[2] and Masao Kimura[3]
[1]Steel Research Laboratories , Nippon Steel Corporation, 20-1 Shintomi, Futtsu, Chiba 293-8511
[2]Nippon Steel Technoresearch Corporation,20-1 Shintomi, Futtsu, Chiba 293-0011
[3]Advanced Technology Research Laboratories, Nippon Steel Corporation, 20-1 Shintomi, Futtsu, Chiba 293-8511

Introduction

It is reported that most of single crystals contain substructures, which depend on their production methods. Dynamic observation has revealed that subboundaries develop in the secondary recrystallized grains during grain growth stage [1-2]. Subboundaries are terminated at the growth front of the secondary recrystallized grain and develop successively along the grain growth direction absorbing dislocations, which generate by grain growth (Fig.1). TEM analysis has shown that these subboundaries consist of edge dislocations. Thus, it is deduced that these subboundaries should have orientation dependence and might have anisotropic distribution.

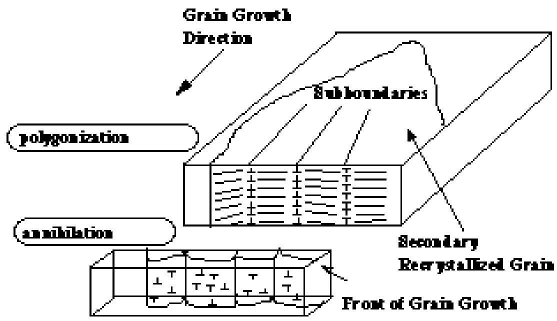

Figure 1 Schematic diagram of the mechanism of subboundary formation during grain growth.

Experimental procedure

To analyze the distribution of the subboundaries, white x-ray topographs were taken with the reflected Berg-Barrett method. Synchrotron x-ray beam was incident to the sample at a glancing angle and asymmetrically diffracted beams were recorded by x-ray film to observe the wide range of the specimen (40×60 mm).

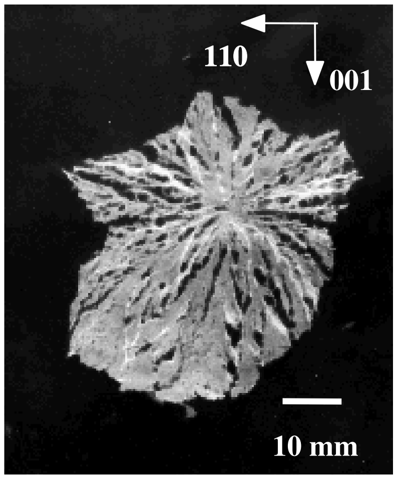

Figure 2 X-ray topograph of {110}<001> secondary recrystallized grain.

Results and discussions

Fig.2 shows the whole range of {110}<001> secondary grain. Subboundaries develop radially from the central nucleation site. It can be seen that the distribution of these subboundaries is anisotropic; subboundarties develop densely in the transverse <110> direction in comparison with the <001>direction.

It is well known that the Burger's vector of 3%Si-Fe crystal is <111> and that the slip planes are {110} and {211}. Thus, the subboundaries, which consist of edge dislocations, are expected to grow in the dislocation lines of <211> and <110>. It is also requested that the dislocation lines should be in the low angel region in the sheet for the continuity of subboundaries. Fig.3 shows the distribution of these dislocation lines which lie within 20 degrees to the sheet plane of the {110}<001> grain. It is clear that the distribution of dislocation lines is dense in the transverse direction and this corresponds to that of subboundaries. It has been clarified that the substructure is anisotropic and this anisotropy can be explained by the above dislocation model.

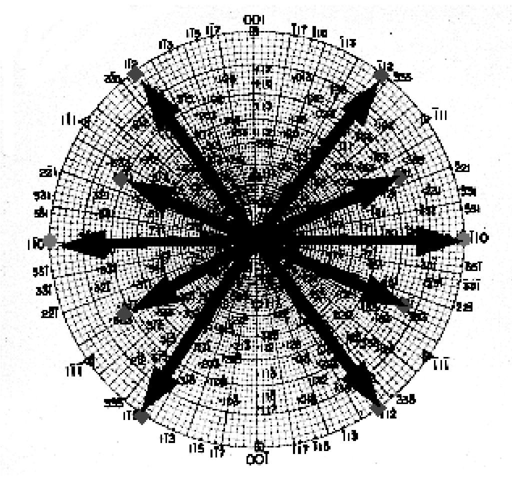

Figure 3 Distribution of <110> and <211> dislocation lines in {110}<001> secondary grain.

References

[1]Y.Ushigami, Y.Suga, N.Takahashi, K.Kawasaki, Y.Chikaura and H.Kii, J. Mater. Eng. **13**, 113 (1991)
[2]Y. Ushigami, K. Kawasaki, K. Murakami, Y. Okazaki, T. Kubota and Y. Chikaura: Proc. 11th Intern. Conf. on Textures of Materials, 560, (1996)

*ushigami@yawata.nsc.co.jp