

Correlation between Initial Recrystallization Texture and Magnetic Induction in Thin-Gauged Electrical Steel

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1. Introduction

It has recently been reported that in 3% Si-Fe strips the texture at time t is governed by the surface-energy-induced selective growth of a grain which is determined by the amount of surface-segregated sulfur: from magnetically detrimental $\{111\}\langle uvw \rangle$ grain to $\{100\}\langle uvw \rangle$ and subsequently to $(110)[001]$ Goss grain in the order of decreasing surface-segregated sulfur concentration.¹ In this study, effects of bulk content of sulfur and final rolling condition on initial and final texture are investigated.

2. Experimental Procedures

In order to investigate correlation between initial recrystallization texture and the final magnetic induction, three kinds of 100 μm thick 3%Si-Fe strips, containing 6, 30 and 300 ppm bulk sulfur, were prepared through vacuum induction melting, hot- and multi-stage cold-rolling processes. Accumulative final annealing was carried out at 1200°C under a vacuum of about 10^{-6} Torr. Texture was analyzed with ODF(orientation distribution function). Magnetic induction was measured by DC-fluxmeter and open circuit method.

3. Results and Discussion

After final annealing for 0.03 ks, the strip containing 6 ppm sulfur showed a strong $(110)[001]$ Goss texture, as shown in Fig. 1. The intensity of Goss texture decreased with increasing bulk content of sulfur. The Goss texture was not observed in the strip containing 300 ppm sulfur which showed the highest concentration of surface-segregated sulfur. This strip, however, showed also a weak Goss texture in the case of final reduction of 40%. The present results imply that, even in the initial stage of final annealing, the surface-energy-induced selective growth of grains occurs on the strip surface,^{1,2} and is influenced by final reduction, determining finally the initial recrystallization texture. After final annealing at 1200°C, those strips in which Goss texture was observed showed final magnetic induction higher than about 1.90 Tesla, as shown in Fig. 2, but much lower magnetic induction of 1.65 Tesla was obtained in the other strips. This can be attributed to the fact that, as the initial intensity of Goss texture increases, the probability for surface-energy-induced selective growth of Goss grains becomes higher within the later sulfur-free time range of final annealing.

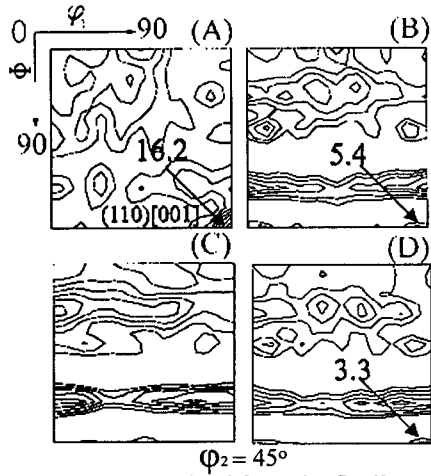


Fig. 1 ODFs obtained from the finally annealed strips for 0.03 ks which containing (a) 6 (b) 30 (c) 300 (80-50-60%) and (d) 300 ppm sulfur (80-62-40%).

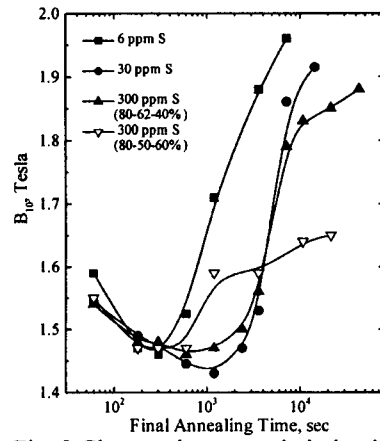


Fig. 2 Changes in magnetic induction with final annealing time.

References

1. N. H. Heo, K. H. Chai and J. G. Na, *Acta mater.* **48**, 2901 (2000).
2. K. H. Chai, N. H. Heo, J. G. Na, H-T Jeong, and S. R. Lee, *IEEE Trans. Mag.* **35**, 3373 (1999)