Effect of Diffusion of {100} Parallel to the ND Plane by Cross Roll Rolling on the Charpy Impact Properties in Low Carbon Steels

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1. Introduction In the α and γ two phase region rolling for low carbon steels, {100} textures have been known to form, leading to a higher frequency of separation fracture and a decrease of the upper shelf energy in the Charpy impact tests [1]. If the {100} texture is diffused, the Charpy impact properties are expected to change drastically. There is a possibility that cross roll rolling can create shear deformation horizontally perpendicular to the rolling direction. It has also been examined that the shear introduced in a cross roll rolling can develop textures different from those produced by conventional rolling [2]. Therefore, in this study, cross roll rolling is applied to low carbon steels with the aim of diffusing the {100} texture, and the effect of {100} texture diffusion on their mechanical properties is examined.

2. Experimental Low carbon steel samples (0.15wt.%C-1.5wt.%Mn-0.3wt.%Si) with a width of 55 mm, a thickness of 50 mm, and a length of 300 mm were annealed for 30min at 1173K and then multi-pass rolled in a reverse manner at 1023K to 10mm thickness at different cross angles, including 0, 5 and 10 degrees. The conventional X-ray diffraction technique with a Cu-Kα radiation was used to measure {100} and {110} pole figures. Charpy impact tests in the temperature range between 78K and 373K were also conducted.

3. Results The whole view of the cross roll rolling mill with its cross angle set at 10 degrees is shown in Fig.1. From this figure, it can be seen that each inner housing that holds either an upper or a lower roll is shifted each other due to the two rolls being crossed each other. The preferred orientation in the {100} pole figure is determined to be predominantly {100} parallel to the ND plane, and its intensity decreases with an increase in the cross angle, as shown in Fig.2. This means that the {100} texture is diffused by increasing the cross angle. The Charpy impact test was conducted on each sample, and the DBTT in the impact absorption energy was found to shift to lower temperatures by more than 50 degrees when rolled at cross angles of 5 degrees as shown in Fig.3. The lowest temperature at which the sample shows an upper shelf energy of higher than 250J is decreased from 248K to 198K by cross roll rolling. The frequency of separation is remarkably suppressed by cross roll rolling.

References

1) S.Matsuda, Y.Kawashima, S.Sekiguchi, and M.Okamoto: *Tetsu to Hagane* Vol.68, (1982),435.
2) T.Hanamura, T.Higuchi, T.Yamashita, O.Umezawa, T.Inoue, S.Torizuka and K,Nagai : CAMP-ISIJ Vol.13(2000)1254.

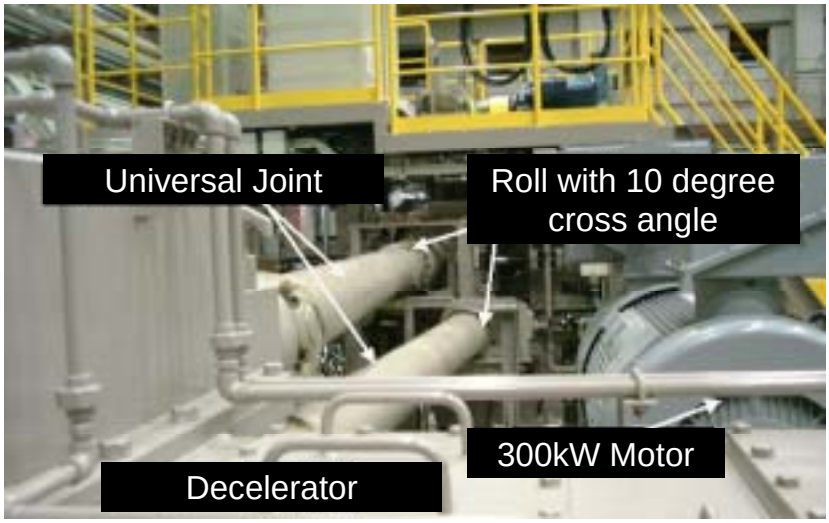

Fig.1: Cross roll rolling mill with the cross angle set at 10 degrees.

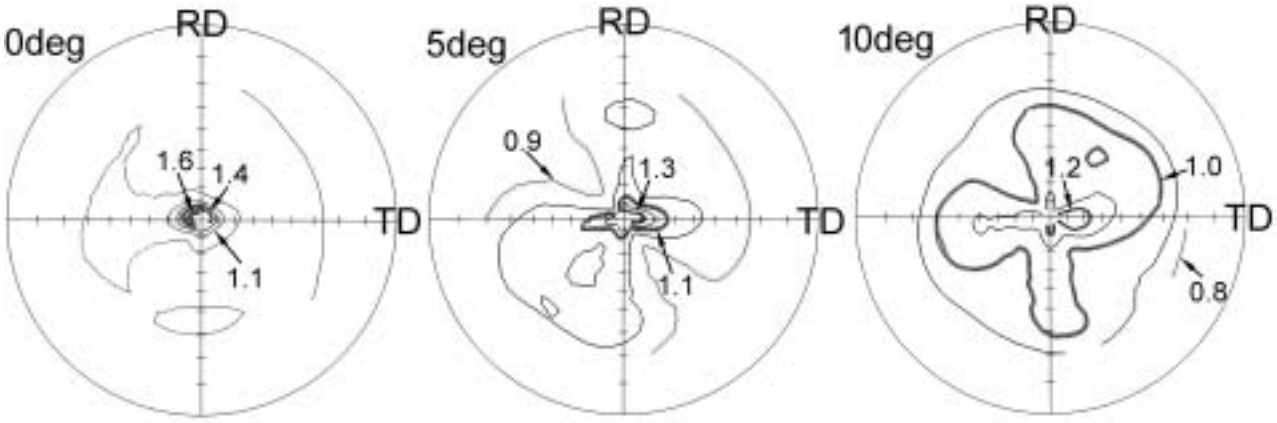

Fig.2: {100} pole figures for low carbon steels cross-roll rolled at cross angles of 0, 5 and 10 degrees.

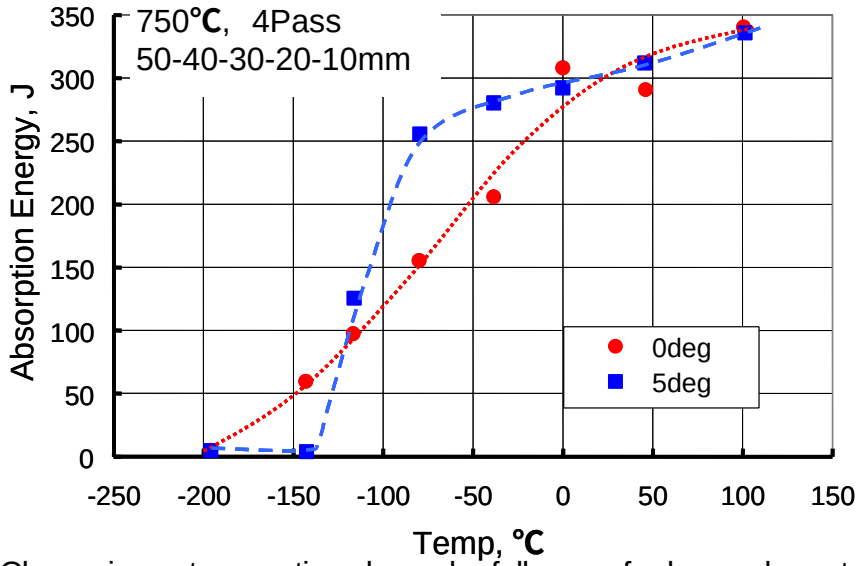

Fig.3: Charpy impact properties shown by full curve for low carbon steels multi-pass rolled with the cross angle of 0 and 5 degrees.