Grain Subdivision Behavior Due to Cold Rolling in Ultra-Low Carbon Steel

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Abstract

Inhomogeneous deformation behavior due to cold-rolling in ultra low carbon steel has been investigated by same sites observation in the longitudinal plane of rolled sheet by SEM and SEM-EBSD technique. Particular attention has been paid to grain subdivision process in crystals. In addition, the local strain distribution due to the formation of the microstructure was investigated by measuring the amount of strain in the grain due to cold rolling using nano-order fine markers applying a focused ion beam (FIB).
The microstructures and the orientation distribution on the longitudinal plane in cold-rolled plate were observed, then some grains which have preferred orientation such as α-fiber and γ-fiber are selected. In order to examine the local strain distribution of these grains due to cold rolling, high-precision dot markers which are 0.3μm in diameter are drawn by using FIB. Then, the sheet was subjected to additional rolling, where the sheet was fitted into a frame made by the same material under a plane strain condition. Using the marker method, local displacement inner the grains due to cold rolling are directly measured.
During rolling at 50-70% reduction in thickness, different crystal rotations were observed in the initial grains. Trace analysis of the slip band suggested that the crystal rotation in different directions was caused by the activation of different slip systems in each region. In addition, the distribution of the equivalent plastic strain from 60% to 70% reduction due to grain subdivision was examined and compared with the change in crystallographic orientation, suggesting that non-uniform slip deviating from the Taylor model was activated in the regions where significant orientation change occurred.

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