Effects of texture on shear band formation in plane strain tension/compression and bending

In this study, effects of typical texture components observed in rolled aluminum alloy sheets on shear band formation in plane strain tension/compression and bending are systematically studied. The material response is described by a generalized Taylor-type polycrystal model, in which each grain is characterized in terms of an elastic-viscoplastic continuum slip constitutive relation. First, a simple model analysis in which the shear band is assumed to occur in a weaker thin slice of material is performed. From this simple model analysis, two important quantities regarding shear band formation are obtained: i.e. the critical strain at the onset of shear banding and the corresponding orientation of shear band. Second, the shear band development in plane strain tension/compression is analyzed by the finite element method. Predictability of the finite element analysis is compared to that of the simple model analysis. Third, shear band developments in plane strain pure bending of a sheet specimen with the typical textures are studied. Regions near the surfaces in a bent sheet specimen are approximately subjected to plane strain tension or compression. From this viewpoint, the bendability of a sheet specimen may be evaluated, using the knowledge regarding shear band formation in plane strain tension/compression. To confirm this and to encompass overall deformation of a bent sheet specimen, including shear bands, finite element analyses of plane strain pure bending are carried out, and the predicted shear band formation in bent specimens is compared to that in the tension/compression problem. Finally, the present results are compared to previous related studies, and the efficiency of the present method for materials design in future is discussed.

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