DEFORMATION BEHAVIOR DURING TWO-STAGE LOADING IN A MAGNESIUM ALLOY SHEET

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ABSTRACT- The deformation behavior during two-stage loading in a magnesium alloy sheet was investigated. In the experiment, the sheet was first subjected to compression. Then small specimens were cut from the sample along various directions and were subjected to tension. During the second loading, a strong in-plane anisotropy was observed in the stress-strain curve. Microstructure observation and a crystal plasticity analysis showed that the difference in the work-hardening behavior would be owing to the difference in the detwinning activity depending on the loading direction.

INTRODUCTION: It is well known that a stress-strain curve exhibits a sigmoidal curve when a magnesium alloy sheet is subjected to tension following compression. On the other hand, the work-hardening behavior when the tensile direction is different from the compressive direction is hardly understood. In the present study, the deformation behavior during two-stage loading was investigated in detail.

PROCEDURES, RESULTS AND DISCUSSION: An AZ31 magnesium alloy sheet was used. The experimental procedure was as follows: (1) In-plane compression was given, (2) small samples were cut from the pre-compressed sample along various directions, and (3) in-plane tension was given. The stress-strain curves obtained from the tension are shown in Fig. 1 (a). θ denotes the angle between the first and second loading directions. The sigmoidal curve occurs for $\theta = 0^\circ$ and 30°, while it is not observed for $\theta = 45^\circ$, 60°, and 90°. Clearly a strong in-plane anisotropy arises. Fig. 1 (b) shows the stress-strain curves obtained using a crystal plasticity finite element method. The tendency observed in the experiment is well predicted. The deformation mechanism is investigated in detail from macroscopic and mesoscopic points of view.

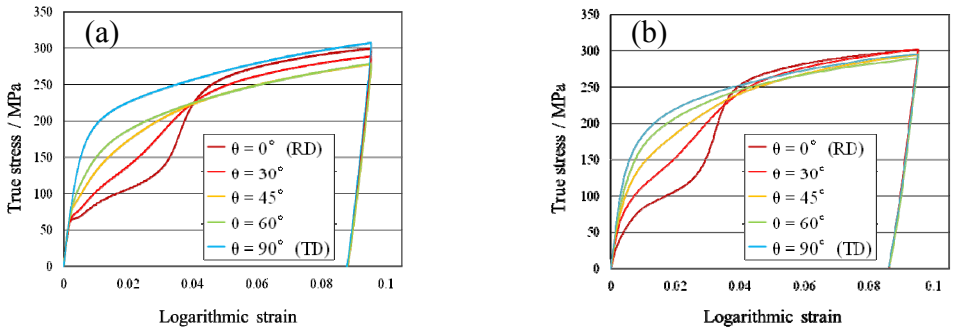

Fig.1 Stress-strain curves during second loading. (a) Experimental and (b) simulation results.