論文の要旨

題　目　Determination of large-strain anisotropic workhardening behavior on high strength steel sheets

（　高張力鋼板の大ひずみ異方硬化挙動の決定　）

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In sheet metal forming processes the material is subjected to different operations leading to a large-strain condition under different stress states as is the uniaxial stress. Usually, the uniaxial stress-strain curve is obtained from the uniaxial tensile experiment, but the main limitation is that the strain obtained is much lower than that experienced in a real forming operations. In this thesis, a new experimental technique of an in-plane stretch-bending experiment to determine the large-strain stress-strain curves of sheet metal under uniaxial stress state is presented.　First, by using the finite element simulation the influence of the sheet anisotropies (i.e. *r*-value, flow stress and shape of yield surface) on the mechanical response is analyzed by using different anisotropic yield functions (i.e. Hill48 and the 6-poly model). Also, the influence of the stretching force level and friction coefficient on the in-plane stretch-bending process is analyzed by the finite element simulation. In this in-plane stretch-bending approach, a stress-strain curve given by uniaxial tension is extrapolated by a constitutive equation of the combined Swift and Voce laws. The weighting coefficient in the combined Swift-Voce equation is determined by minimizing the difference in the stretch-bending mechanical responses, i.e., punch stroke (or load) vs. maximum bending strain, between the finite element (FE) simulation and the corresponding experimental result. This method is verified by performing experiments on five types of high-strength steel (HSS) sheets (the dual-phase type 590Y, 780Y, and 980Y and the precipitation type 590R　and 780R). By using the in-plane stretch-bending experimental results and its corresponding finite element calculation in an inverse analysis approach, the stress-strain curves are determined for strain levels of more than twice the achieved uniaxial-tension uniform elongations in all the sheets. Also, by using the Yoshida-Uemori kinematic hardening model the effect of the Bauschinger effect on the in-plane stretch-bending behavior is discussed. The large-strain anisotropic hardening behavior is analyzed by comparing the large-strain stress-strain curves obtained by the in-plane stretch-bending (uniaxial stress), bulge test (biaxial stress) and shear test (shear stress) using a 590R sheet. Finally, using the in-plane stretch bending experiments, the *r*-value anisotropy at large strain is determined for the 590R sheet in three rolling directions (i.e. 0°, 45° and 90°).