第 1 号様式

学位論文概要

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 this research work, an in-plane stretch-bending experiment to determine the large-strain stress-strain curves of sheet metal is presented. The development of this new experimental technique comprises a detailed analysis on the using of the hardening models and an accurate description of the sheet anisotropies (*r*-value and flow stress) by using advanced plasticity models. The prediction of the large-strain curves different sheet direction behavior (i.e. 0^0 , 45^0 and 90^0) is based on an inverse analysis approach using the stretch-bending experimental results and finite element simulation. The contents of the present work are summarized as follows:

In Chapter 2, the modeling of the hardening models and the anisotropic yield criteria used for the calculations are explained in detail. Furthermore, the mechanical properties obtained from the experimental tests i.e., uniaxial tensile test, Young's modulus test, in-plane biaxial test and cyclic tension-compression test on five metal sheets (three levels of Dual-Phase sheets i.e. 590Y, 780Y and 980Y; and two levels of precipitation hardening type i.e. 590R and 780R sheet) are reported.　Also, the flexibility of the yield functions on the description of the *r*-value and flow stress anisotropies as well as the shape of the yield function is presented.

In Chapter 3, the experimental setup and FE model of the proposed in-plane stretch-bending test for the determination of the large-strain workhardening under uniaxial stress-state are explained. Next, the effect of the stretching force level on the sheet formability and the friction effect on the material response are analyzed using the finite element simulation. Furthermore, the influence of the sheet anisotropies and hardening models are discussed by using isotropic and anisotropic yield functions.

In Chapter 4, the experimental results of the in-plane stretch-bending test and its prediction by the inverse analysis approach as well as the determined large stress-strain curves in the sheet rolling direction　0^0 are presented. Furthermore, the influence of the Bauschinger effect is analyzed by using the kinematic hardening model of Yoshida-Uemori (Y – U model).

In Chapter 5, a parameter identification scheme for the determination of the Swift and Voce hardening models based on an effective stress formulation which is able to describe the flow stress anisotropy evolution of the sheets is used. Also, a comparison of the stress-strain curves determined by the uniaxial tensile and stretch-bending tests under uniaxial stress-state with those from the bulge and shear tests is presented. Last, based on the proposed stretch-bending test the *r*-value anisotropy at large strain is determined.

Finally, Chapter 6 summarizes the general conclusions of this dissertation and gives some perspectives with respect to applications of the presented test on the sheet metal forming field.