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Experimental and numerical prediction on square cup punch–die misalignment during the deep drawing process

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Abstract:

Punch–die misalignment is one of the factors that can contribute to drawn cup defects such as thinning and tearing. Deep drawing is a closed-die process, and defects can be identified only after the drawing is finished. In this work, the effect of punch–die misalignment severity on the drawing force and wall thickness distribution of electrolytic zinc-coated steel blank (SECC) was investigated. The stress–strain diagram and forming limit diagram of SECC material was determined and simulated using the Hill’48 model. Two conditions of punch–die misalignment were studied: single-axis and multi-axis misalignment. A high punch–die misalignment severity contributes to the increment in the drawing force. Furthermore, wall thickness distribution becomes non-uniform, and the thinning pattern increases due to the greater misalignment severity. For validation, an experiment was conducted on a universal tensile machine.