Numerical modelling of microforming processes

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It is well recognized that expertise, experience, and theoretical knowledge available in conventionally sized metal forming cannot be simply transferred to microforming. This is due to so-called size effects which have distinct effect on material flow, friction and other process characteristics [1,2].

Today, process simulation is a standard tool in industry, applied to support process layout and its optimization. However, as it is based on continuum mechanics, it is size-invariant at least for cold forging. Hence, it is obvious that due to the size effects, conventional simulation cannot be applied to microforming. At the LFT two approaches have been developed within the past years how to model numerically the specific phenomena of microforming in particular concerning material flow and friction. These are the mesoscopic model [3] and a combination of the general friction law and mechanical rheological model [4], respectively. Both models can be brought together to be finally applied to a combined micro cold-extrusion process [5].

The present presentation is focussed to the mesoscopic model, the basics of which are summarized in the first part. The second part is dedicated to a newly developed experimental technique facilitating the in situ observation of material flow in bulk metal just to quantify those phenomena which are characteristic for microforming standing in contrast to macroforming such like inhomogeneous flow and inhomogeneous shape evolution [6]. The experimental results can be used to validate the numerical model.


(Reprints of cited literature are available on request)