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Hard coatings on tools and carbon dioxide as volatile lubrication for dry metal forming

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Breaking new ground, but never losing sight of the goal, is essential in order to meet the increasing technical and statutory requirements. Low oil lubrication consumption in sheet metal forming plays an increasingly important role as the effects of lubricant application on the environment or health become more and more relevant. In addition, residual oil contaminations are a problem for subsequent processing steps such as painting.
In this paper, a promising combined approach for a dry process design and the fundamental feasibility of this new hybrid technology is given. First, a novel approach for temporary lubrication of deep-drawing processes with CO_2 as a volatile medium is used. This process allows for the introduction of an intermediate medium into the tribological system under high pressure by means of laser drilled micro-holes. After the metal forming process, no cost-intensive purification steps are needed since the volatile medium vaporizes without residue debris under ambient pressure. Second, dry metal forming can be supported by a hard coating system such as silicon nitride coating (Si_3N_4). By using both CO_2 lubrication and hard coatings, metal sheet forming with low coefficients of friction is possible. In this study, exchangeable drawing jaws with laser drilled micro-holes are provided with hard coatings and subjected to an exemplary strip drawing test. As analyzing methods, the surface energies of the plasma coating on the tool before and after the strip drawing tests are determined by means of contact angle measurements under liquid CO_2. The results from the strip tensile tests show a low coefficient of friction for a low surface pressure. The next step will be the implementation of this hybrid technology on a tool for deep drawing an U-Profile.
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Keywords
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friction coefficient
hard coating