Investigation on the Tribological Behavior of Tool-sided Tailored Surfaces for Controlling the Material Flow in Sheet-Bulk Metal Forming

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Abstract. The increasing demand for closely tolerated and highly integrated functional components motivates the development of the new process class sheet-bulk metal forming (SBMF). SBMF is defined as the application of bulk forming operations on sheet metal to produce components with integrated functional elements. Due to varying tribological loads, caused by the local forming of functional elements and the resulting complex material flow, the geometrical accuracy of the produced components can be limited. A local increase or decrease of the friction by surface modifications, also called tailored surfaces, to control the material flow is an approach to improve the geometrical accuracy of the components. These tailored surfaces should be applied tool-sided to guarantee a short process chain. Consequently, the aim of this study is to analyze the potential of modified tool surfaces for a usage as tailored surfaces in SBMF processes. The tribological behavior of tailored tool surfaces is investigated to provide a basis for the selection of tailored surfaces. Different grinding and blasting strategies as well as lubrication pockets are chosen and applied on the tool steel 1.3344 with a hardness of 61 ± 2 HRC as surface modifications. The modified surfaces are compared to lapped tools as a reference, since lapping is a widespread finishing for forming tools. First of all, the topographies of the modified surfaces are characterized using optical and tactile measurements. Afterwards, the tribological behavior of the surfaces is investigated using a modified ring compression test with specimens made of 1.0338. The resulting friction factors are correlated with the topography characteristics of the tailored surfaces to identify functional interrelations. Finally, the tailored surfaces are evaluated regarding their eligibility to adapt the friction and control the material flow in SBMF-processes.