Hot stamping integrated mechanical surface treatment for the manufacturing of hybrid structures

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Abstract

The automotive industry faces the challenge of developing innovative strategies in order to comply with the emission restrictions demanded by politics and society. Lightweight design is one strategy to reduce the overall vehicle mass and thus mass-induced emissions. Hybrid structures made of high-strength steels and fiber-reinforced-plastics (FRP) are a promising approach to reduce vehicle mass compared to conventional design due to their high lightweight potential, especially in the area of crash-relevant body components. One of the main challenges in the production of plastic-metal hybrid (PMH) components is to ensure the bonding of the different materials. By mechanical treatments the surface of the metallic component can be structured and an improved load transmission in the hybrid component can be achieved. This paper presents a hot stamping process-integrated mechanical surface treatment. In this process approach, macroscopic interlocking elements are generated by structuring tools during hot stamping of high strength 22MnB5 steel. In addition to an increase in the joint surface, the structures create a mechanically interlocking joint between the metallic and plastic components, which improves the energy absorption and transmission of tensile and shear forces within the hybrid component. The process-integrated manufacturing of interlocking structures is investigated by the development and design of a prototype structuring platform. Furthermore, a finite element model has been developed and validated by an evaluation of the structuring experiments. The aim of the investigation is the process and tool optimization for the production of load-adapted interlocking structures in the field of hybrid components.

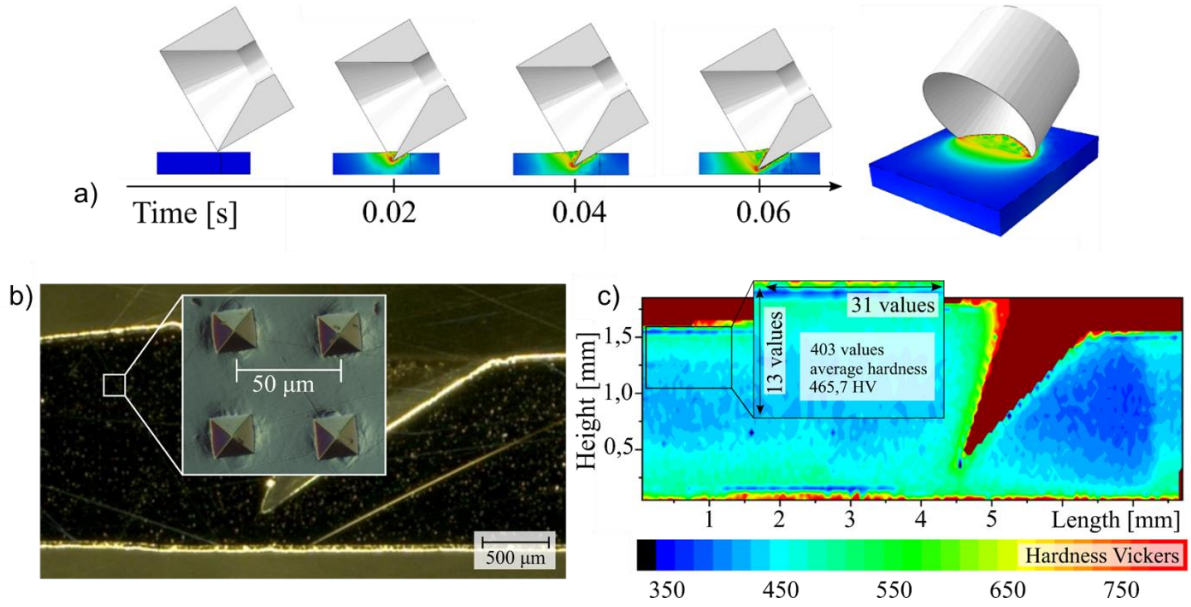

Figure 1: a) FEM simulation of the structuring process; b) Measured surface hardness of the cross-section; c) Visual representation of the surface hardness by color-coded values