Lehrstuhl für Umformtechnik und Gießereiwesen (*utg*)
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Flat rolling of extruded Al/Cu composite strips with geometrically designed interfaces

Motivation

The basis of this research project is the investigation of the bond between aluminum-steel hybrid cylinders produced by continuous composite casting. The fundamental micromechanical and microstructural properties of Aluminium/Steel hybrids are investigated experimentally and by simulation.

To this end, a description of the mechanical behavior of continuous-cast material composites over the process chain is being developed. This is based on the microstructural properties of the interface area and takes metallurgical and micromechanical aspects into account. The time-consuming experimental work involved in optimizing the mechanical properties at both the process and metallurgical levels is thus reduced. The interfacial microstructures are analysed and the mechanical behavior of the hybrid is characterized. Different mechanical and optical characterization methods are used.

Approach

To describe the failure behavior in the composite zone, a model is developed in each case for the formation of the interfacial microstructure as well as for the description of the deformation behavior. This approach allows a more detailed understanding of the complex interaction between the process parameters, the formation and evolution of the interfacial microstructures and the final mechanical behavior of the composite.

The results of the metallurgical investigation are incorporated into the model for the formation of the interfacial microstructure. Since the mechanical behavior of the material composites is closely related to the interfacial microstructures, a detailed understanding of the diffusion-reaction behavior at the aluminium/steel interface must be generated. In this context, diffusion reaction experiments are further developed aiming at isolating the time and temperature effects to analyze the kinetic growth of the intermetallic layers. In addition, the experiments allow the calibration and validation of the predictive model for the interfacial evolution. The developed simulation model calculates the influence of the continuous casting process parameters on the intermetallic thickness growth.

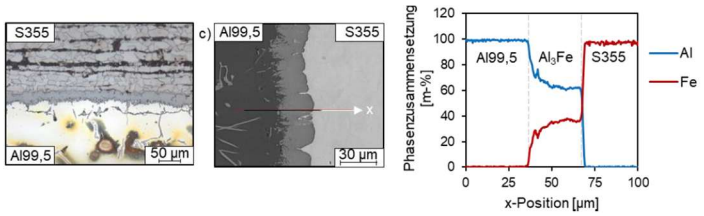

Figure 1: Structural Characterization of Cast Aluminum-Steel Composites

Procedure and outlook

The results of the mechanical investigation together with the results regarding the formation of the interfacial microstructure are included in the model for the deformation behavior. The deformation and fracture behavior of the interface is analyzed using push-out and Brazilian tests. By matching experimentally determined strain fields with numerical models based on in situ high-speed recordings, both the validation of the underlying elastoplastic material behavior and the identification of suitable predictive models describing the failure of intermetallic phases and adjacent structures are performed.

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