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Characterisation of solidification processes during transient liquid phase bonding with rapidly solidified brazing ribbons from the melt spinning process

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Abstract. In technical joining processes, such as brazing, locally molten phases are generated in the workpiece, forming a metallurgical bond between filler metal and base material. Heat input, melting and solidification processes can thereby lead to shrinkage, mismatch and warpage. Furthermore, different process parameters, such as heating rate and holding time, influence the formation of the joining zone and especially the development of the microstructure. Due to the limited possibilities to influence these factors directly and by additional mutual interactions of these factors, the precision and reproducibility of the joints is reduced. As a consequence, rejects arise or post-production steps become necessary to remove defects, such as shrinkage, mismatch and warpage. Therefore, the aim of an interdisciplinary research group at the RWTH Aachen University is to achieve high precision in joined components by controlling and manipulating the factors determining the precision during the joining process. To reach this goal, in a first step the factors that influence precision are analysed.

The Transient Liquid Phase (TLP) bonding is a brazing method based on diffusion of braze metal constituents into the base material and of base metal constituents into the braze metal leading to isothermal solidification. The aim of this study is to analyse the timescale of the solidification and the diffusion processes of the constituents. For this purpose rapidly solidified Sn based braze ribbons from the melt spinning process were brazed at high vacuum with aluminium casting alloy for highly dynamically stressed components for automobile and engineering industry. Prior to the brazing experiments the microstructure of the braze ribbons was analysed by electron microscopy. The melting ranges were examined by differential scanning calorimetry (DSC). The braze seam was analysed by scanning electron microscopy with respect to the phase fractions in dependence of the composition of the ribbons.



Corrosion investigations by using gel-type electrolytes

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Abstract. Limitations are encountered regarding the electrolyte when studying atmospheric corrosion reactions on materials that form protective layers on their surface or tend to passivate. For example, the reconstruction of a thin wet film, as well as the interpretation of electrochemical measurements in so-called bulk solutions (a "mass" of electrolyte), often proves to be difficult in view of corrosion behavior under atmospheric conditions. A new approach to this problem in corrosion research includes the use of gel-type electrolytes as an alternative to bulk electrolytes. Gel-type electrolytes form a thin wet film on the surface of the material, whereby the naturally formed protective layer is affected similar to atmospheric conditions and can be examined in an almost non-destructive way. Through electrochemical instrumentation specific values such as polarization resistances and corrosion currents can be determined providing information on kinetics of surface layer formation and stability of surface layers formed under the influence of a thin wet film. Thus, new test methods can be developed that supply a better understanding of corrosion processes in specific atmospheres.

In this article different zinc coatings and aluminium alloys were investigated, their naturally formed protective layers were electrochemically characterized and corrosion relevant values were determined by using a gel pad based on polysaccharide. Corrosion relevant values allowed the differentiation of various coating systems and could describe the current protective effect provided by the coating. It is shown that gel-type electrolytes influence protective layers and coatings considerably less than corresponding bulk electrolytes and that an atmospheric wet film is approached by these test conditions. From the results it is evident that gel-type electrolytes represent a viable and promising field in corrosion research.