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In situ high energy X-ray diffraction during transient liquid phase bonding of a γ-TiAl alloy

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TiAl alloys are increasingly being used as a lightweight material, for example in aero engines, which also leads to the requirement for suitable repair techniques. Transient liquid phase bonding is a promising method for the closure of cracks (in non-critical or non-highly loaded areas) and is already used for Ni-base superalloys. Two different brazing solders, based on Ti-Fe and Ti-Ni, have been investigated for brazing a γ-TiAl alloy. After brazing, the joints exhibit different microstructures and phase compositions. Additionally, tensile tests at room temperature show different mechanical strengths depending on the brazing solder.
For a better understanding of the brazing process, the phases, their development and distribution over the brazing zone were investigated, time and position resolved, during the brazing process. These investigations were performed using high-energy X-ray diffraction at the HZG-run high-energy materials science beamline HEMS, located at the synchrotron radiation facility at DESY in Hamburg, Germany.
During the analysis of the diffraction data with Rietveld refinement, the amount of liquid could be quantified using Gaussian peaks. Additionally, the degree of ordering of the β_o phase was determined with a model of two ideal stoichiometric phases (completely ordered and disordered). During brazing different phases occurred in the joint region over time. The phase composition changed clearly over the first six hours of the brazing process.

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