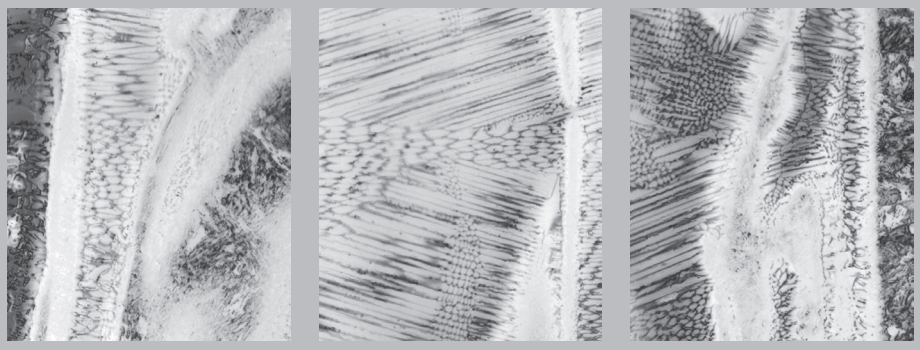

3

WELDING DISSIMILAR JOINTS OF ULTRA-HIGH STRENGTH AND SUPRADUCTILE STEELS

Task

When laser radiation is used for the fusion welding of differently alloyed steels, mixing of either alloy causes alterations of the alloy of the fused zone. Local changes of composition impair the microstructure, and hence, the mechanical properties of the welded joint. Since it is difficult to predict these properties, the mixture and the resulting distributions of the alloying elements should first be determined in order to understand the flow during processing and its effects on weld quality.

Method

Samples of combinations of press-hardened chromium steel or dual-phase steel with high-manganese steel were produced under variable parameters during welding tests on lap joints. Element analysis with EDX as well as low load hardness testing was used to evaluate the results metallographically. The mechanical properties were tested in KS2 and shear tensile tests.

Results

Combining the three analysis methods makes it possible to precisely determine the resulting phases. A wide range of microstructures between austenitic and martensitic appear with different varieties in all connections. It was not possible to determine if the local alloys influenced the strength since failure occurred in the heat-affected zone of the dual-phase steel or the martensitic steel. In combination with the mid carbon martensitic chromium steel, heat treatment leads to a considerable improvement in strength. The mapping of the local alloys in the COHMS diagram shows that the assumptions made there are valid, also for laser-beam welded joints.

Applications

The fundamental work presented here shows the strengths and weaknesses of the respective analysis and testing methods. Especially for the strength tests, adjustments to the test part geometry are still necessary in order to examine the weld seam itself. These adaptions will provide a procedure to assess dissimilar fusion welds for almost all applications in the sheet metal processing of steel.

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3 Local microstructure formation by varying mixing in the weld.