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MANUFACTURE OF ALUMINUM-STEEL BIMETAL BY FRICTION STIR WELDING

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A new trend in industry is the use of multi-layered, heterogeneous materials in the design of responsible use. This type of material, called poly- and bimetals, is used in shipbuilding, aerospace, machinery and other industries. Aluminum-steel bimetals are often used in applications requiring high strength, lightness and corrosion resistance at the same time, as well as for welding aluminum and steel through an adapter. Production of such bimetals by traditional fusion welding methods is complicated by the appearance of brittle intermetallics at the interface. A reliable solution can be to produce aluminum-steel bimetals by friction stir welding.

The purpose of this study is to reveal the features of the joint formation of stainless steel 12Cr18Ni10Ti and aluminum alloy 5056 by friction stir welding.

The thickness of AA5056 sheet was 1.5 mm, steel plates 12Cr18Ni10Ti - 5 mm. Friction stir welding was performed on the side of the aluminum sheet overlapping on the steel sheet. For welding the tool from tool high-speed steel T11302-M2 with length of a pin of 1.5 mm was used. Welding was carried out at different technological parameters: rotation rate 800-1000 rpm, axial force on the tool 700-850 kg, feed rate 250-350 mm/min. The weld structure was studied using optical light and scanning electron microscopy.

The geometry of the experiment was organized in such a way that the pin of the tool in the process of welding in order to avoid wear stirred only the material of the AA5056 and did not touch the steel substrate, but at a high force created by the lifting movement of the aluminum material also due to the adhesion forces tightened the material of the steel substrate. This effect is generally called "hooking", since the substrate material to be tightened has a hook shape. It has been established that changes in the technological parameters of friction stir welding affect the size of this hook. In particular, the largest hook was observed at medium parameters, which provided the greatest adhesion. Thus on boundary of layers on all modes there was no formation of brittle intermetallics, and joint represented a mechanical mixture.

From the results of the study it can be concluded that the formation of a bimetallic aluminum-steel joint by friction stir welding does not require contact between the tool and the substrate, and the most influential factor in the quality of the joint is adhesion.