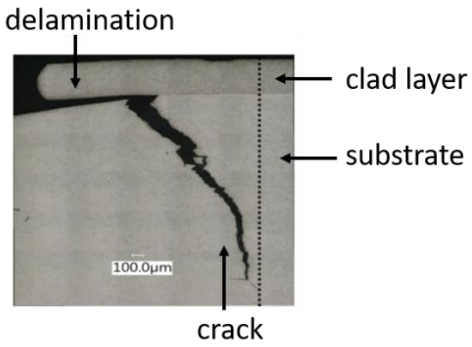
**Solid state additive manufacturing of aluminium alloys by Friction Surface Cladding;**
***Bond strength measurement, modeling and optimization***

Additive manufacturing of high strength aluminium alloys by fusion based approaches is often limited by the occurrence of solidification related defects. Solid based approaches form a worthwhile alternative where the temperature during deposition remains below the respective metal points of the materials involved. This may lead to lower heat input and to a fine microstructure positively influencing the mechanical properties (strength, toughness) of the manufactured product.

Experiments performed with the in-house developed solid state Friction Surface Cladding (FSC) technology have shown that various aluminium alloys can be deposited well. Homogeneous clad layers without porosity, cracks or other defects can be made within a relatively broad process window.

Recently, a first, mostly experimental study towards the bonding strength of the deposited layers has been conducted. In the study three point bending tests were performed to "obtain bonding strength information", see also the figure below. However, a more thorough analysis is required to fully understand all phenomena (for example crack formation) occurring during the bending tests. Moreover, it is not completely clear if the type of tests performed provide sufficient information.




*Deformation, delamination and crack formation during three-point bend testing*

**Objectives**

The objectives of the research project are to characterize the bonding strength of the deposited layers to the substrate and to find ways to improve the bonding strengths. The following aspects should be included:

(i) Analyze the three point bending test method as a way to characterize the bond strength (across the width of the deposited layer). Possibly suggest better approaches.
(ii) Establish (model based) relations between the bond strength, the process conditions, the materials and the tool design.
(iii) If time permits: make validated suggestions to modify the tool design to improve the clad layer-substrate bonding strength.

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