Press Release IX / 2017
Laser structuring improves adhesion on metal and protects the environment

Scientists of the Fraunhofer IWS Dresden and the Fraunhofer IFAM Bremen have developed a novel technology for the large area, efficient and environmentally friendly pre-processing of fiber glass metal laminates (GLARE). This new technology has been jointly developed within the framework of the aeronautical research project » AUTOGLARE- advanced metal fuselage construction- fiber glass reinforced aluminum and automated manufacturing processes for high production rates in the aircraft industry; Sub-project NFM-GLARE «. The adhesively bonded multilayer composites, pre-processed by laser, verifiably provide excellent adhesion and corrosion properties so that chemical pre-processing in anodizing bathes are no longer necessary.

The project (FKZ: 20W1517D) started in September 2015 and is coordinated by AIRBUS. It is funded by the Federal Ministry of Economics and Technology, based on the decision of the German Bundestag.

In the aerospace industry GLARE is considered as a lightweight material with significant potential for the future. It consists of several aluminum and fiber layers, each only a few tenths of millimeters thick. The benefits of the new material, compared to pure metals, are an improved burn-through and impact behavior and an enhanced fatigue behavior due to delayed crack propagation. However, due to very low quantities, the production of these semi-finished components is scarcely automated and thus much cost and resource consuming. Together with several research and industrial partners IWS and IFAM scientists are researching on basic technologies for an automated GLARE production.

They focus their research on the development of processes, which make surface pre-processing, hitherto basing on wet-chemical techniques, more efficient and environmentally friendly. The alternative technology has to face demanding challenges. Conventional anodizing baths do not only clean the surface but also improve the adhesion to the fiber reinforced film by means of surface enlargement and activation.

The IWS approach bases on the pre-processing of the adhesive joint by means of cleaning and structuring via laser radiation. So far, pulsed laser systems have been applied for material ablation, because only this kind of laser delivers the high intensity necessary for metal evaporation. Unfortunately, these laser systems can only process few square centimeters. Within this project, however, surface structuring of several square meters is required and thus a considerably more efficient laser system becomes necessary.

For the pre-processing procedure the IWS scientists apply a high power, continuously emitting solid state laser and the remote technology. The excellent radiation focusses in kilowatt range and the simultaneous quick spot movement across the substrate enables a reproducible material ablation. In order to achieve a good productivity the laser spot is linearly moved across the surface with a speed of 300 m/s. This process enables ablation rates of currently one square meter per second. In comparison, a wet-chemical pre-processing in different baths takes at least 20 minutes.

The structures of 10 µm and more, generated on the aluminum surface, enable an optimum adhesion to the bonding film. Studies of the Fraunhofer IFAM Bremen have demonstrated that the laser process enables the ablation of the native, often porous oxide film and the generation of a homogeneous interface with clearly improved corrosion properties.

Visit us at the Hannover Messe Industrie trade show (April 24 – 28, 2017) in hall 6/ booth A30 (»Industrial Supply«).

Laser structuring system at Fraunhofer IWS Dresden
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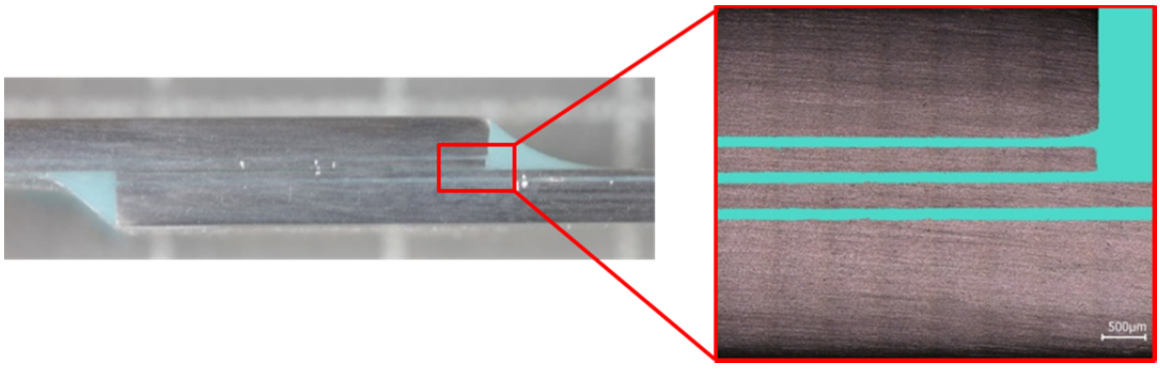

Test geometry for the analysis of adhesion properties (GLARE)
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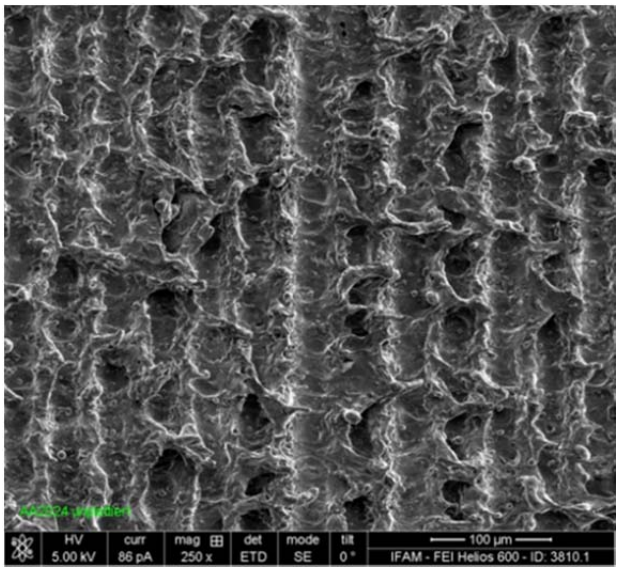

REM-image of a surface processed with a cw laser
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Gefördert durch:

Bundesministerium
für Wirtschaft
und Energie

aufgrund eines Beschlusses
des Deutschen Bundestages