

ENVIRONMENT-FRIENDLY METALLIZATION OF CFRP

Carbon fiber reinforced plastic (CFRP) is a composite material made of carbon fibers and a polymer matrix, in many cases epoxy resin. This high-performance material is mainly used in the aerospace sector. In addition to a low specific weight, CFRP has outstanding mechanical properties such as high mechanical stiffness, which means that this material is frequently used as a substitute for heavier metal materials. However, for some applications CFRP components have to be coated. For the ESA's Sentinel 1 mission, waveguide antennas made of CFRP were electrolytically metallized at the Fraunhofer IST in order to give them adequate electrical and thermal conductivity.

Metallization of CFRP

The metallization procedure for the Sentinel mission was developed and implemented by the Fraunhofer IST in collaboration with Airbus Defence and Space. In addition, the CFRP antennas for the Mascot mission of the German Aerospace Center (DLR) were metallized at the Fraunhofer IST.

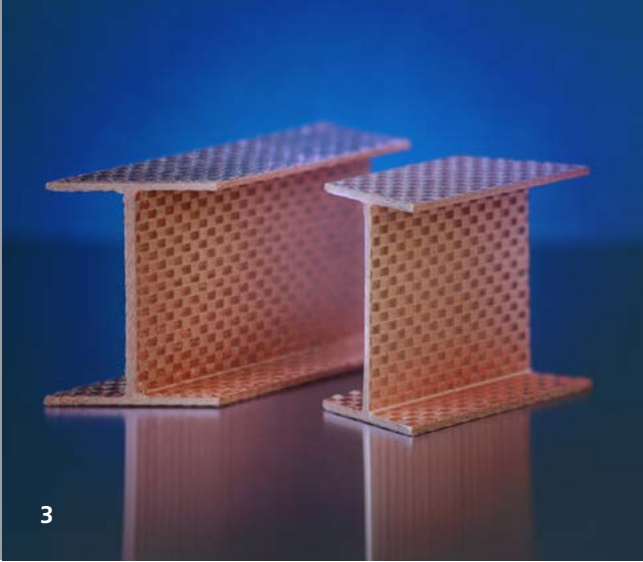
Although this procedure was developed to readiness for series production and is currently being used again it does have one serious drawback: pretreatment of the CFRP material involves the use of, among other things, chromium sulfuric acid containing hexavalent chromium which is acutely toxic and carcinogenic. According to the EU's REACH regulation (where REACH is an acronym for the registration, evaluation, authorisation and restriction of chemicals) the use of substances containing hexavalent chromium will be severely restricted in future, possibly put under prohibition.

Conventional pretreatment

So far there is no alternative to using the chromium sulfuric acid in the electrolytic metallization of many plastics. With the help of the etching agent the surface of the plastic is artificially roughened and holes and cavities thereby created. These holes are then also metallized. The mechanical interlocking of the plastic and the metal coating results in good adhesion (pushbutton effect).

Lasers make small holes

In a joint project with the Fraunhofer Institute for Laser Technology ILT in Aachen, the Fraunhofer IST has developed an innovative, environment-friendly process for pretreating CFRP which does not use hexavalent chromium compounds. In this method a laser beam burns a large number of small holes into the surface. The spacing and size of the holes resemble the bites produced during chemical etching. The next



steps are similar to those of the conventional metallization of plastic: palladium activation, electroless metallization and further electrolytic coating for reinforcement. Even direct metallization is possible. In addition to the usual flat specimens, complex three-dimensional parts were also adherently metallized.

Potential applications

Alongside the laser pretreatment and metallization of CFRP components it has also been possible to coat other polymers by this method. However, the high cost and complexity of this method means that it will initially be restricted to expensive workpieces.

1 CFRP surface after laser pretreatment.

2 Cross-section of a CFRP surface after laser pretreatment and metallization.

3 3D CFRP component after laser pretreatment followed by metallization.

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