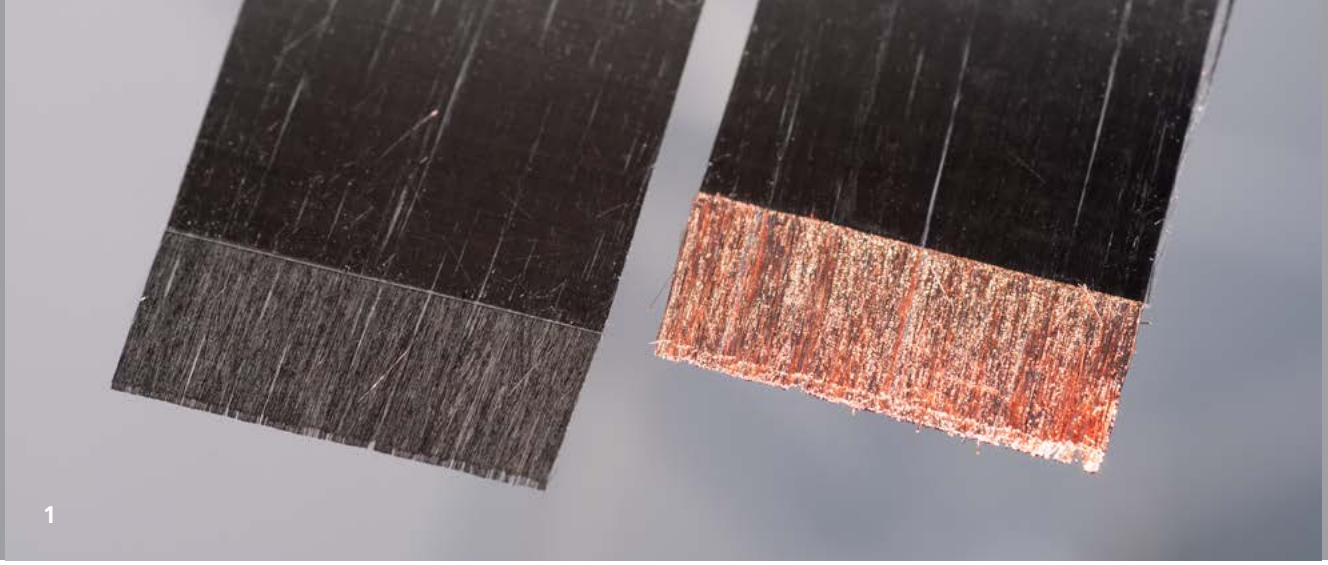

1

FILIGREE ELECTROPLATING: METALLIZED CARBON FIBERS

Due to its excellent mechanical properties and low density, carbon-fiber-reinforced plastic (CFRP) plays an outstanding role as a structural material in the aerospace sector. As a composite material, CFRP is, for example, galvanically metallized and used as waveguide antennas for satellite applications. This method has now been further developed at the Fraunhofer IST to the point that even individual fiber bundles can be metallized and used for certain applications.

CFRP composite material

Due to its outstanding mechanical properties, CFRP has major advantages for structural components as compared with metallic materials. For example, the modulus of elasticity of CFRP at a density of 1.58 g/cm³ (magnesium: 1.74 g/m³) falls between 240 and 930 GPa (magnesium: 42 GPa) depending on its fiber orientation. Unlike metallic materials, CFRP is however a relatively poor electrical conductor. For this reason the Fraunhofer IST together with Airbus Defense & Space, formerly Astrium GmbH Deutschland, have collaborated on developing a galvanic procedure for metallizing entire CFRP components. It has already been used successfully for the metallization of waveguides for the ESA satellite Sentinel 1.

CFRP fibers

In a current project with Airbus Defense & Space success has been obtained in galvanically metallizing even individual carbon fiber bundles which, due to their extremely high thermal conductivity, are used as flexible thermal bridges for aerospace applications. The aim was to apply a copper coating to the carbon fibers so as to create a solderable connection with other metal components. The challenge here was the mechanical instability of the fibers. The original component consisted of a CFRP composite with unidirectional oriented fibers and a resin matrix. Before the fiber ends could be electro coated, they had first to stand clear of the resin matrix.

Fraunhofer Institute for Surface Engineering and Thin Films IST | Bienroder Weg 54 E | 38108 Braunschweig | Germany

2

1 *Individual leaves of a flexible high-performance thermal bridge before and after copper plating.*

2 *Metallized carbon fibers.*

Although the CFRP composite, in other words, the fiber-resin composite, does have outstanding mechanical properties, the individual fiber bundles, also called rovings, are very fine and fragile. This meant that special supports had to be built to protect the rovings against mechanical influences during metallization. Even the further processing of the metallized fibers represented a major challenge since great mechanical stresses arise especially at the phase boundary of metal coating and fiber and these stresses resulted in fiber fracture.

Outlook

The selective metallization of carbon fibers is a further step in the use of CFRP in aerospace applications. More applications are planned. Individual metallized fibers in a CFRP fabric can accordingly improve electric conductivity so as to provide excellent lightning protection in aircraft, for example. Fibers of this kind are also suitable for use as sensors to detect mechanical damage.

CONTACT

Dr. Andreas Dietz
Phone +49 531 2155-646
andreas.dietz@ist.fraunhofer.de