Fraunhofer IWS Dresden

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS

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remocut®FRP – LASER TREATMENT OF FIBER REINFORCED POLYMERS

Laser cutting and ablating with high power and high precise remote systems

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Task

Lightweight structures, based on a combination of high stiffness fiber reinforced polymer materials and tailored part geometries, can fulfill the worldwide market requirements for energy saving products. Advanced fiber production technologies, high fiber utilization degrees and fully integrated process chains have to be developed to overcome the actual cost limitations of these structures. Furthermore, flexible and easily automated treatment processes are required.

Laser treatment

The laser as a precise wear free tool enables flexibility and automation. It is well integrated into the global market of cutting and processing of metals. The cutting of fiber reinforced polymers by the conventional gas assisted fusion process leads to unacceptable edge qualities. Causes are the different sublimation or decomposition temperatures of the fibers and the matrix material and the high heat energy input. Here, the laser remote technology opens up new possibilities.

Solution

The technology **remocut®FRP** (**f**iber **r**einforced **p**olymer) developed at the Fraunhofer IWS enables laser cutting or ablating of high performance fiber reinforced materials with minimized heat influenced areas. A fast mirror system based on galvanometer scanners is used to rapidly project the laser beam onto the material. The mirrors work with high precision even at high path velocities. Accelerations of several 10 g are achievable. The high processing speeds guarantee short interaction times between material and beam.

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In combination with a multi cycle treatment the heat input at the processing area can be controlled. Using adapted ablation strategies, cuts with high aspect ratio are possible within the working field of the scanner. An example are cuts and holes at carbon fiber epoxy resin composites up to 4 mm thickness with excellent kerf quality.

Potential

In combination with brilliant laser sources, different composite materials, such as
- pliable fabrics,
- preforms and
- consolidated parts

can be cut, trimmed or partly ablated.

The technology advances are particularly shown at final trimming of near-net-shape parts. These complex parts favorably processed by a tailored fiber placement technology can be trimmed without any force input and tool wear and in an automated and flexible manner.

Remote systems with variable wavelengths and interaction times

Depending on the material composition different laser wavelengths and operation modes are needed. Continuous wave lasers with high laser power are used for high productive cuts; pulsed lasers are recommended for best cut qualities or selective ablation tasks.

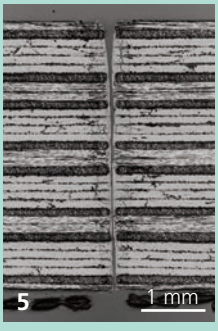
The possibility to adapt different laser sources (wavelength and /or operation modes) at one high dynamic beam deflection optics enables combined processes for periodic or simultaneous treatment. Therefore, the depended absorption degrees of the single materials can be taken into account with different wavelengths.

Coaxial vision system

The advantage of lightweight structures is the fabrication of near-net-shape parts. These mostly 3D parts can favorably be treated or trimmed by using laser remote processing. To guarantee a precise treatment, the laboratory equipment possesses a coaxial vision system. Using a dichroic mirror, the camera system monitors the position and size of the part to be treated inside the scanner working field. The software calculates the deviations between programmed and real part geometry and adjusts the control code of the remote system. Flexible and precise processing is the achievement.

Material and component portfolio

- carbon, glass, aramid and basalt fiber fabrics with thermoplastic and thermosetting polymer matrix
- short, long and endless fiber reinforced parts
- pliable and consolidated 2D or 3D parts



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1 remocut®FRP of organo sheets
2 Cutting samples, glass fiber polypropylene, 1 – 4 mm
3 Tensile specimen, carbon fiber epoxy resin, 2 mm
4 Isogrid structure, laser trimmed
5 Cross section of 4 mm CFRP