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Comparison of Yb and Tm-Fiber Laser Cutting Processes of Fiber Reinforced Plastics

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Abstract : Due to its favourable material characteristics, fiber reinforced plastics are amongst the main topics of all actual lightweight construction megatrends. Especially in transportation trends ranging from aeronautics over the automotive industry to naval transportation (yachts, cruise liners) the expected economic and environmental impact is huge. In naval transportation components like yacht bodies, antenna masts, decorative structures like deck lamps, light houses and pool areas represent cheap and robust solutions. Commercially available laser tools like carbon dioxide gas lasers (CO_2), frequency tripled solid state UV lasers, and Neodymium-YAG (Nd:YAG) lasers can be used. These tools have emission wavelengths of 10 µm, 0.355 µm, and 1.064 µm, respectively. The scientific goal is first of all the generation of a parameter matrix for laser processing of each used material for a Tm-fiber laser system (wavelength 2 µm). These parameters are the heat affected zone, process gas pressure, work piece feed velocity, intensity, irradiation time etc. The results are compared with results obtained with well-known material processing lasers, such as a Yb-fiber lasers (wavelength 1 µm). Compared to the CO_2-laser, the Tm-laser offers essential advantages for future laser processes like cutting, welding, ablating for repair and drilling in composite part manufacturing (components of cruise liners, marine pipelines). Some of these are the possibility of beam delivery in a standard fused silica fiber which enables hand guided processing, eye safety which results from the wavelength, excellent beam quality and brilliance due to the fiber nature. There is one more feature that is economically absolutely important for boat, automotive and military projects manufacturing that the wavelength of 2 µm is highly absorbed by the plastic matrix and thus enables selective removal of it for repair procedures.

Keywords : Thulium (Tm) fiber laser, laser processing of fiber-reinforced plastics (FRP), composite, heat affected zone
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