Mechanical characterization of Titanium - fiber laminate composite with laser-textured metallic surface

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Recent scientific literature reports a growing demand for aircrafts with high structural stiffness, which has greatly stimulated the development of new classes of hybrid fiber-metal laminates (FML) [1]. As metal-polymer interlamellar fracture resistance is still a big challenge in materials science and engineering [2], this paper aims to demonstrate the positive role of laser-micro texturing of metallic foil surfaces in the mechanical performance of TiGr-5 FML [3]. A 2 KW high power Yb-fiber laser beam installed in the Multiuser Laboratory of Development and Applications of Lasers and Optics (DedALO/IEAv-CTA) was focused within a 10^4 μm^2 spot area on the surface of the moving Ti-alloy sheet. The laser was programmed to emit 2 ms pulses with peak power varying from 100 W to 300 W (Figure 1). Each pulse generates a micro-cavity on the metal sheet surface. By varying time between pulses it was possible to control micro-cavities spacing. The highest average roughness obtained was 6.78 µm using a 300 W laser power and a cavity spacing of 250 µm. FML plaques were then manufactured by hot-press consolidation. Short beam strength test coupons [4] were extracted from FML in order to compare the mechanical performance of laser-textured laminates with those subjected to conventional sand-blast and chemically attacked metal surface treatments [5]. Stiffness, ultimate stress, specimen deflexion and tenacity at maximum load were the parameters utilized to rank the laminates´ behaviour. Topographical inspection of fracture surfaces was carried out to shed some light on the macro- and micromechanisms operating at the metal-polymer interfaces submitted predominantly to shear stresses.

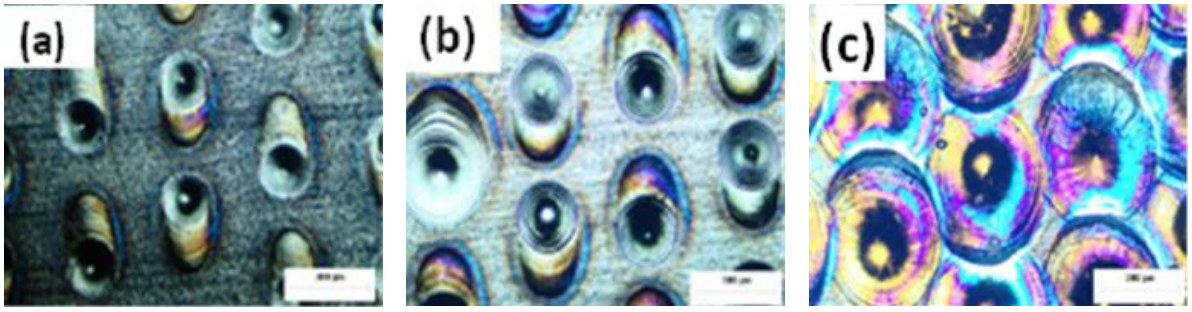

Figure 1: Ti6Al4V sheet surface textured with laser powers of 100 W (a), 150W (b), and 300 W (c).

Keywords: hybrid fiber-metal laminate, laser in manufacturing, mechanical properties.

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