STIFFNESS AND HARDNESS SURFACE GRADIENT IN TI PARTS BY LASER SURFACE ALLOYING

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Titanium and its alloys are commonly used as structural materials due to their high relative strength [Leyens, 2003] and as biomaterials due to their biocompatibility, replacing other materials as steels and Co-Cr alloys [Geetha, 2009]. However, one of the main disadvantages of them is the low resistance to wear. Several surface treatments have attracted interest for enhancing wear and corrosion resistance, biocompatibility and fatigue strength [Zaveri, 2008]. The aim of this work is the manipulation of the surface stiffness of commercial pure titanium parts, obtained by laser surface alloying with preplaced powders [Tian, 2005]. We used sheets of commercially pure titanium grade 2 as substrate and Nb and Cu powder as alloying material. The powder was mixed with acetone to form a slurry, which was applied on the substrate. After drying of acetone, there was obtained a thin and homogeneous layer of copper powder on the substrate. For the laser processing, we used Ytterbium fiber laser, and the laser power was varied at 200, 300 and 400 W while the scanning speed of the laser beam and the distance between the focus of the laser beam and the surface of the plate was kept constant at 10 mm / s and 10 mm, respectively. Cords isolates were obtained, which were characterized by scanning electron microscopy, energy dispersive spectroscopy X-ray and X-ray diffraction. The modulus and hardness of the modified layer were determined by instrumented indentation. By varying the process parameters, the alloy composition and the obtained phases can be controlled. Using Nb powder, an alloy with about 30% of Nb was formed on the surface of the titanium, which microstructure was composed by Ti-β and martensitic Ti-α´´ phases (Figure 1-a). Such modification decreased the elastic modulus and increasing the hardness. Using Cu powder, Ti_2Cu intermetallic compound was formed at the surface (Figure 1-b), increasing the elastic modulus and strongly increasing hardness. Laser surface alloying allowed the manipulation of the surface stiffness to higher or lower values of the bulk. It is expected that lower stiffness surface can increase the fatigue life of titanium parts [Fogagnolo, 2013].

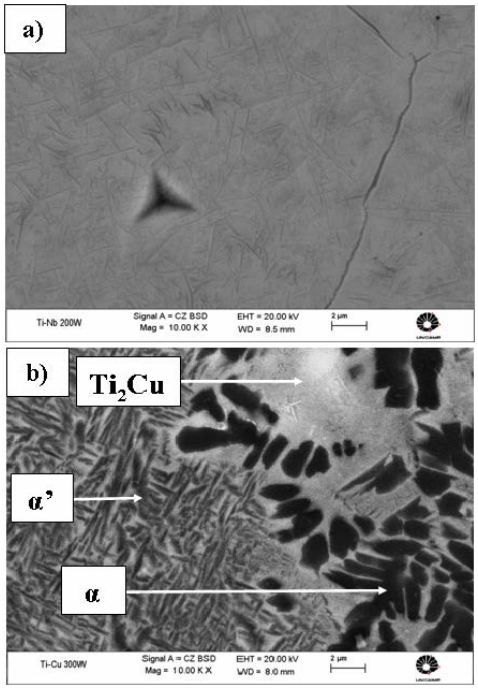

Figure 1: Microstructure of the alloys obtained at the surface using Nb (a) and Cu (b) powder.

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