LASER-ASSISTED COATING OF TI6AL4V SUBSTRATE WITH ZRC

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Laser coating is an advanced coating technology used for improving the surface properties of metal components. The coatings produced are thick, dense, and crack-free with continuous non-porous microstructures having uniform composition which results in them displaying excellent metallurgical bonding properties [1] and have minimal dilution with the base material.

Ti6Al4V has received tremendous attention in the biomedical application following stainless steel and cobalt based alloy, but it appears to release toxic ion in an oxygen depleted environment [2]. Ti6Al4V can be coated with Zirconium Carbide which indicate to have outstanding neurotic properties which including good mechanical properties at elevated temperatures and adequate aqueous corrosion resistance [3].

Ti6Al4V specimen was prepared and preplaced with Zr powder mixed with cold glue ($C_4H_6O_2$) to form a 1.0 mm thick powder bed. The laser coating process was performed on the bed using a RoffinSinar DY044, CW Nd:YAG laser. The beam spot size, scan speed and laser power were 1 mm, 1 mm/s and 500 W respectively. The experiment was conducted in Argon shielded environment, at flow rate of 2 l/min. Optical and scanning electron microscope (SEM) equipped with energy dispersive spectroscopy (EDS) was used for examining the specimen. The hardness profile of the laser cladded sample was obtained using a Matsuzawa hardness tester at a load of 50 g in an interval of 100 µm from the edge of the clad.

Results showed bonding with minimal dilution to the substrate as shown in Figure 1, with the presence of pores and a small crack showing. The layer is obtained from single laser pass with multiple line scans of 25 mm in length and 0.08 mm overlap.
The microstructures shown in Fig. 2 consist of dendrites that are randomly distributed on the deposited layers. The presence of carbon from the cold glue reacted to produce a ZrC dendrites characterised with complex microstructures that are varying in regions. These microstructures change in morphology from the top of the coating to the bottom. At the center it presents grain boundaries separating the parallel plate structures mixed with basket-weave microstructure with matrix α-phase. EDS analysis quantified this presence of ZrC dendrites in a Zr matric. The hardness increase from 342 HV to ~ 900 HV in an interval of 100μm from the top down of the clad to the substrate.

References
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3. She, *et al.* (2010), Material Science and Engineering, 527, 6454-6458.

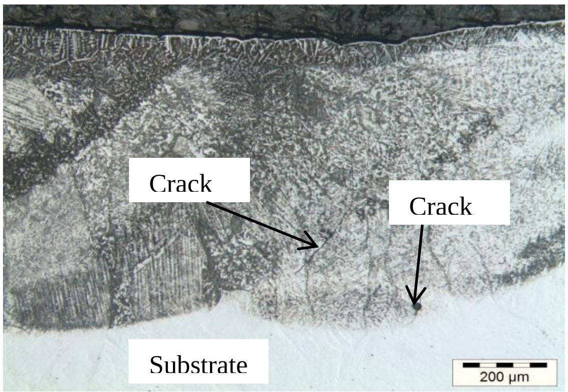

Figure 1: Optical micrograph showing the bonding of the coating

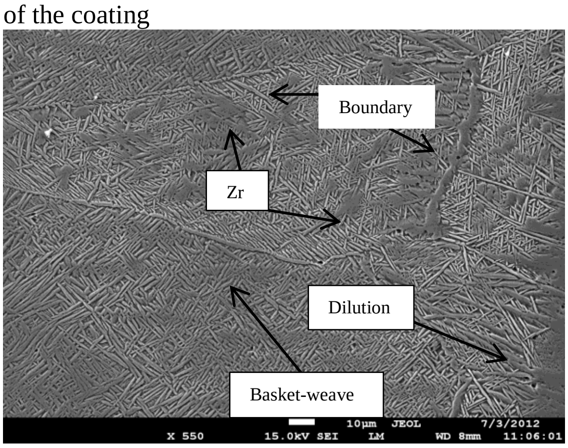

Figure 2: SEM micrograph showing complex microstructure of Zr/ZrC dendrites.

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