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Processing of hard white cast iron surfaces by PTA alloying

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Abstract – An iron-based alloy (Fe-15Cr-2.5Ni-0.5Mo) was deposited on gray cast iron substrates by plasma transferred arc (PTA). Alloying was promoted changing the current intensity, current mode and scanning speed. Microstructure and hardness evaluation showed that significant changes in the chemical composition occurred leading to the development of a hard white iron layer.

Equipment and components that operate in industrial environments are submitted to severe working conditions. In these environments, phenomena such as corrosion, elevated temperatures and wear are the main causes of failure. PTA is a hardfacing technique that presents advantages when compared with other welding processes (e.g. alloying for in-situ alloy processing as powder mixtures are deposited). The higher hardness, wear resistance and lower cost of iron-based alloys makes them widely used compared to nickel and cobalt-based alloys [1, 2]. This study aimed to evaluate the development of hard high chromium iron-based surfaces through alloying by deposition of powder mixtures on gray cast iron in order to produce a layer of hard white cast iron.

The alloy with nominal chemical composition Fe-15Cr-2.5Ni-0.5Mo was prepared using commercial powders with 75-150 μm particle size range. The deposition was done by plasma transferred arc processing on gray cast iron substrates. Different alloying conditions were obtained changing the processing parameters: deposition current mode (continuous and pulsed), intensity (150 and 200 A) and scanning speed (50 and 100 $mm.min^{-1}$). Feeding rate was kept constant at 4.22 $g.min^{-1}$ and only argon was used as plasma, shield and carrier gas. Deposits were characterized by their microstructure using optical and scanning electron microscopy, X-ray diffraction and Vickers hardness.

A strong influence of the processing parameters on the developed microstructure was identified. The deposits processed with 150A exhibiting a net of M_7C_3 eutectic carbides in a soft austenitic matrix. The deposition current increasing to 200A intensifies the mixture of the deposition material with the gray cast iron resulting in harder surfaces where the higher content of C changed the microstructure. M_3C carbides and dendrites with a eutectoid component (α-solid solution and M_3C) were identified. The higher heat input caused a more significant mixture with the cast iron substrate enriching the coatings with C from the substrate. A change to pulsed current mode resulted in finer structure associated with the lower heat input and a mixture of austenite, M_3C and M_7C_3, was identified. Processing with a faster scanning speed affected more significantly surfaces processed with a pulsed current causing a reduction in hardness and larger amounts of austenite together with M_3C carbides.

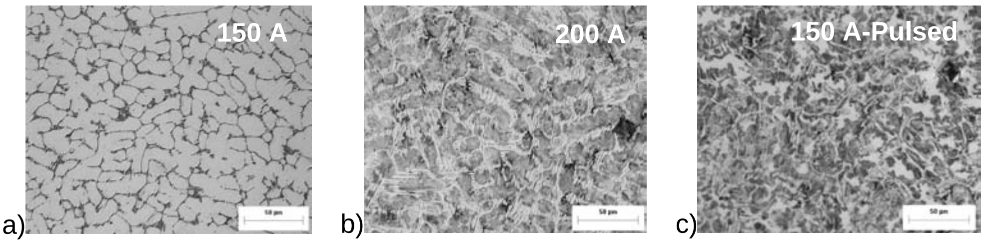

Figure 1: Fe-15Cr alloy microstructures deposited by PTA. All deposits with a 50 $mm.min^{-1}$ scanning speed.

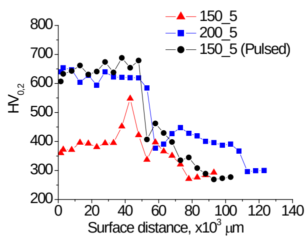

Figure 2: Microhardness profile of the samples showed in Fig. 1.

References

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