

## Decomposition of Solidification Carbides during Cyclic Thermal Treatments in a Co-Based Alloy Deposit Applied to Stainless Steel

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**Abstract :** A cobalt-based alloy type Co-Cr-Ni-WC was deposited by plasma transferred arc projection (PTA) on a stainless steel valve. The alloy is characterized at the equilibrium by a solid solution Co ( $\gamma$ ) mainly dendritic, and eutectic carbides  $M_7C_3$  and  $\eta M_6C$ . At the deposit/substrate interface, this microstructure is modified by the fast cooling mode of the alloy when applied in the liquid state on the relatively cold steel substrate. The structure formed in this case is heterogeneous and metastable phases can occur and evolve over temperature service. Coating properties and reliability are directly related to microstructures formed during deposition. We were interested more particularly in this microstructure formed during the solidification of the deposit in the region of the interface joining the soldered couple and its evolution during cyclic heat treatments at temperatures similar to those of the thermal environment of the valve. The characterization was carried out by SEM-EDS microprobe CAMECA, XRD, and micro hardness profiles. The deposit obtained has a linear and regular appearance that is free of cracks and with little porosity. The morphology of the microstructure represents solidification stages that are relatively fast with a temperature gradient high at the beginning of the interface by forming a plane front solid solution Co ( $\gamma$ ). It gradually changes with the decreasing temperature gradient by getting farther from the junction towards the outer limit of the deposit. The matrix takes the forms: cellular, mixed (cells and dendrites) and dendritic. Dendritic growth is done according to primary ramifications in the direction of the heat removal which takes place in the direction perpendicular to the interface, towards the external surface of the deposit, following secondary and tertiary undeveloped arms. The eutectic carbides  $M_7C_3$  and  $\eta M_6C$  formed are very thin and are located in the intercellular and interdendritic spaces of the solid solution Co ( $\gamma$ ).

**Keywords :** Co-Ni-Cr-W-C alloy, solid deposit, microstructure, carbides, cyclic heat treatment

**Conference Title :** ICMM 2019 : International Conference on Mining and Metallurgy

**Conference Location :** Dublin, Ireland

**Conference Dates :** May 07-08, 2019