Laser cladding of metal/ceramic composites for wear applications

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To increase the lifetime of mechanical parts submitted to severe abrasive environments, a common strategy is to reinforce their top surface by depositing a more resistant layer. This approach is particularly interesting for metallic parts exhibiting a poor wear resistance at high temperature. The incorporation of a dispersed ceramic phase within the reinforcing layer is known to dramatically enhance the resistance and the hardness of the top surface layer.

In the present work, laser cladding was used to fabricate thick metal/ceramic coatings on steel substrates. Laser cladding is a melting process in which the laser beam is used to fuse an alloy and/or a composite directly onto a substrate. This technique can be processed in one or two-step. In the one-step method, powders are fed directly into the melt pool whereas in the two-step method, powders are pre-placed onto the substrate and then laser treated. In this work a one step method was considered with a 1 kW Nd:YAG laser source operating in a continuous mode and equipped with a Precitec co-axial nozzle.

Metal matrix composite (MMC) coatings composed of Ni- and Co-matrix alloy containing hard tungsten carbides have been considered to improve the wear resistance of steel (S235 low carbon steel) parts. The secondary phase amount and its dimension have been studied. In order to limit the formation of cracks during the layer cooling down subsequent to laser cladding, the influence of a pre- and post- heating of the sample was assessed. Similarly, the effect of a bond-coat to improve adherence and limit the thermal mismatch between the coating and the substrate was investigated.

It is shown that a net improvement of the wear properties can be obtained although the suitable range of process parameters is very narrow.

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