Abstract

Laser surface processing of advanced ceramic coatings plays an important role in industrial applications because of its high quality and modifications which it provides. One of these applications is processing of advanced oxide ceramic coatings that are developed by plasma spraying technique. The coatings produced by this process suffer from many defects like porosity, voids, microcracks, cracks, and high surface roughness in addition to these coatings have lamellar structure. With these defects the performance of coating layers is degraded, therefore laser surface processing must be introduced to enhance their properties and increase their resistance to the external effects.

In this work mild steel and inconel – 600 were used as a substrate, then it was coated by bond coating of NiAl alloy. The bond layer was applied by low-pressure plasma spraying technique (LPPS). Zirconia-based, alumina-based and composite coating (alumina-zirconia coating) were deposited above the bonding layer by atmospheric plasma spraying technique (APS). The optimum spraying parameters were selected and fixed and used during the period of this work to make correct comparison between the results of the as-sprayed and as-treated layers.

Before laser processing, the coating layers were characterized for microstructure, microhardness, porosity, surface roughness, thermal cycling, thermal shock, and fracture.

The plasma-sprayed oxide ceramic coatings were processed by pulsed Nd: glass laser with 300 μ sec pulse duration and $\lambda = 1.06 \mu m$ wave length. Different laser processing parameters were applied to specify the optimum parameters that fulfill the best coating specification of processing by laser. The optimization results of power density, specific energy show that the best results can be obtained for power density when the distance between the target and lens is 40 mm, for most of energies, and the best overlapping percentage can be obtained at (50%).

Microstructural studies of single and overlapped laser tracks have been made by using optical microscopy (OM), scanning electron microscopy (SEM). Extensive studies using SEM have been made of plane views and transverse sections of the ceramic layers to evaluate the surface morphology, depressions, porosity, cracks, track width, track depth, and the height of sealing.

Detailed X-ray analysis was carried out to determine the phases, proportion of the phases. The effect of the laser processing on the structure, quality and amount of the phases of plasma – sprayed advanced ceramic coatings were determined.