Interface Bonding of Nicraly Coating on Laser Modified H13 Tool Steel Surface

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ABSTRACT

Bonding strength of thermal spray coatings depends on the interfacial adhesion between bond coat and substrate material. In this paper, NiCrAlY (Ni-164/211 Ni22 %Cr10 %Al1.0 %Y) coatings were developed on laser modified H13 tool steel surface using atmospheric plasma spray (APS). Different laser peak power, P_p, and duty cycle, DC, were investigated in order to improve the mechanical properties of H13 tool steel surface. The APS spraying parameters setting for coatings were set constant. The coating microstructure near the interface was analyzed using IM7000 inverted optical microscope. Interface bonding of NiCrAlY was investigated by interfacial indentation test (IIT) method using MMT-X7 Matsuzawa Hardness Tester Machine with Vickers indenter. Diffusion of atoms along NiCrAlY coating, laser modified and substrate layers was investigated by energy-dispersive X-ray spectroscopy (EDXS) using Hitachi Tabletop Microscope TM3030 Plus. Based on IIT method results, average interfacial toughness, K_{avg}, for reference sample was 2.15 MPa $m^{1/2}$ compared to sample *L*1 range of K_{avg} from 6.02 to 6.96 MPa $m^{1/2}$ and sample *L*2 range of K_{avg} from 2.47 to 3.46 MPa $m^{1/2}$. Hence, according to K_{avg}, sample *L*1 has the highest interface bonding and is being laser modified at lower laser peak power, P_p, and higher duty cycle, DC, prior to coating. The EDXS analysis indicated the presence of Fe in the NiCrAlY coating layer and increased Ni and Cr composition in the laser modified layer. Atomic diffusion occurred in both coating and laser modified layers involved in Fe, Ni and Cr elements. These findings introduce enhancement of coating system by substrate surface modification to allow atomic diffusion.

KEYWORDS: NiCrAlY; H13 tool steel surface; Interface bonding

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