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Abstract

New results about the scratch adhesion resistance of nickel boride layer on Inconel 718 superalloy were estimated in the present study. The nickel boride layer was developed on the surface of Inconel 718 superalloy by means of the powder-pack boriding process conducted at 1173 K with 2, 4, and 6 h of exposure. The microstructure of the nickel boride layer was analyzed from optical microscopy, X-ray diffraction and energy dispersive spectroscopy (EDS). Furthermore, and before the scratch tests, indentation properties of the nickel boride layers such as hardness, Young's modulus, and the distribution of residual stresses were evaluated using Berkovich nanoidentation tests applying a constant load (50 mN) across the diffusion layers. The scratch tests were performed over the surface of the nickel boride layer-substrate systems using a Rockwell-C diamond indenter with a continuously increasing normal force from 1 to 80 N, whereas the behavior of the coefficient of friction and the residual depth as a function of the scratch length were monitored during the tests. For the determination of the critical loads, the combination of acoustic emission signal with microscopic observations of the worn tracks were used; the critical loads were estimated at which the layer cracks (cohesive failure) or is detached (adhesive failure) and they explained according to the mechanical properties of the nickel boride layer-substrate system. For all the set of experimental conditions, the presence of three types of failure mechanisms over the worn tracks were detected, while the results showed that the critical loads increase with enhancing nickel boride layer thickness.

Keywords: boriding; nickel boride layer; scratch test; indentation properties; critical loads; failure mechanisms.

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