Surface Characteristics and Tribological Properties of Ti – Al Intermetallic Compound Coatings on Ferrous Substrates

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Abstract

Titanium aluminide intermetallic compound coatings were produced on carbon tool steel surfaces by a two stage pack titanisation and aluminisation process. The coatings were subsequently diffusion annealed at a range of temperatures and times. The diffusion time and temperature at each stage were optimized in order to control the tribological behavior of the coatings formed. Metallographic, microhardness, X-ray diffraction, and glow discharge optical spectroscopic techniques were used to identify coating and interface regions, and the results show that coatings were produced with graded compositions and properties. Tribological tests were conducted on a conventional reciprocating wear test machine under dry conditions, and the worn surfaces and wear debris were examined by SEM. The results of wear testing indicate that titanium aluminide coatings improve the wear behavior of carbon tool steel significantly. Subsequent diffusion annealing of the titanium aluminide coatings significantly enhanced the wear resistance of the steel substrates, with a friction coefficient of less than 0.2 being maintained over many test cycles. These results confirm the feasibility of producing a Ti ± Al intermetallic compound layer for use in hostile environments.