Abstract

A hard coating is obtained on low carbon steel (AISI 1025 steel) substrate by the action of a high power laser beam on a powder mixture of Al, TiO_2 and hBN preplaced on the substrate surface. The precursor powder mixture undergoes self-propagating high-temperature synthesis (SHS) at the high temperature induced by the incident laser. The products of SHS are subsequently laser alloyed onto the substrate, whereby, a hard, nanostructured coating is formed comprising of Al_2O_3, TiB_2 and TiN which are produced *in-situ*. This Al_2O_3-TiB_2-TiN composite coating, containing reinforcements produced *in-situ*, is superior in microstructure and mechanical performance to the coating with same composition but with reinforcements produced *ex-situ*, i.e. by laser alloying of Al_2O_3, TiB_2 and TiN powders on low carbon steel substrate. Addition of excess hBN in the precursor resulted in the presence of free hBN in the coating. Coefficient of friction (with WC-Co as counterbody) of the coating is found to reduce with increase in hBN content in the precursor, resulting in a coating with a property combination of high hardness, low wear rate and low friction coefficient. Laser post treatment of the coatings caused distinct enhancements in microhardness and tribological performance. This Al_2O_3-TiB_2-TiN composite coating produced by combined SHS and laser surface alloying has considerable potential in tribological applications. The knowledge and information thus generated are not only of academic importance but also of relevance to actual users and industries involved in the manufacture of hard, wear resistant and self-lubricating coatings.

Keywords: Laser; Alloying; Microhardness; Wear resistance; Solid lubrication, Post-treatment