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**Low friction behaviour of boron carbide coatings ( $B_4C$ ) against Ti-6Al-4V****S. Bhowmick, G. Sun, A.T. Alpas\***

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**ABSTRACT**

Boron carbide ( $B_4C$ ) is a potential tool coating for machining of titanium alloys because of its high hardness and high temperature stability. In addition,  $B_4C$  coatings annealed at 600 °C, form a layer of that acts as solid lubricant leading to low coefficient of friction, COF, against titanium. This paper shows that a transfer layer consisting of graphite could be established on  $B_4C$  surface when sliding against Ti-6Al-4V and passivation of graphitized carbon would reduce COF. Ball-on-disk ( $B_4C$ ) type sliding tests were performed in dry air, argon and nitrogen atmospheres (<0.5% RH), and in air with humidity levels varying between 25% and 85% RH.  $B_4C$  samples were also tested while they were immersed in water, ethanol ( $C_2H_5OH$ ) and iso-propyl alcohol ( $C_3H_7OH$ ). The  $B_4C$  coatings exhibited high COF values of 0.59-0.65 in dry atmospheres. Sliding under an air atmosphere containing 70% RH reduced the steady state COF to 0.25 and further reduction COF to 0.20 was recorded in air with 85% RH. A COF of 0.15 was measured when the tests were carried out in ethanol and 0.07 in iso-propyl alcohol. Low COF values of  $B_4C$  were attributed to H and OH passivation of the graphitized transfer layers observed by the Raman, Fourier transform and X-ray photoelectron spectroscopy techniques.

**Key words:**

*Boron carbide; humidity; lubrication; passivation; graphitization*

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