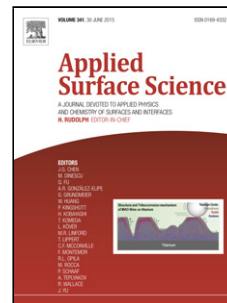


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Boron doped *bcc*-W films: Achieving excellent mechanical properties and tribological performance by regulating substrate bias voltage

Lina Yang ^a, Kan Zhang ^{a,*}, Yi Zeng ^a, Xin Wang ^b, Suxuan Du ^a, Chuanying Tao ^a, Ping Ren ^a, Xiaoqiang Cui ^a, Mao Wen ^{a,*}

^a State Key Laboratory of Superhard Materials, Department of Materials Science, and Key Laboratory of Automobile Materials, MOE, Jilin University, Changchun 130012, People's Republic of China.

^b College of Physics, Jilin University, Changchun 130012, People's Republic of China

*Corresponding author:

E-mail address: kanzhang@jlu.edu.cn; Tel. /Fax: 86-431-85168444.

Wenmao225@jlu.edu.cn; Tel. /Fax: 86-431-85168444.

Highlights

- B doped *bcc*-W films were grown by magnetron co-sputtering W and B targets.
- Phase transition from γ -W₂B+ α -W(B) to α -W(B) was observed with increasing V_b .
- 6.7 at.% B doped *bcc*-W film shows twice higher hardness than pure W.
- α -W(B) film possesses very low friction coefficient of ~0.18.

Abstract

Boron doped *bcc*-W (WB_x, x=B/W) films were deposited on Si(100) substrates by magnetron co-sputtering pure W and B targets. Our results reveal that when the absolute value of substrate bias voltage (V_b) increases from floating to 240 V, the value of x monotonously decreases from 0.18 to 0.04, accompanied by a phase transition from a mixture of tetragonal γ -W₂B and body-centered cubic α -W(B) phase ($-V_b \leq 60$ V) to α -W(B) single phase ($-V_b > 60$ V). Hardness, depending on V_b , increases first and then drops, where the maximum hardness of 30.8 GPa was obtained at $-V_b = 60$ V and far higher than pure W and W₂B theoretical value. In the mixed phase structure, the grain boundaries strengthening, Hall-Petch effect and solid-solution strengthening induced by B dominate

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