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Bonding structure of B-C-N ternary compounds grown by ion beam assisted deposition and their tribomechanical properties.Ignacio Caretti¹, Ignacio Jiménez²¹Materials Science Institute of Madrid, Madrid, Spain ²Materials Science Institute of Madrid, Madrid, Spain

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B-C-N solid solutions have received considerable attention due to their promising chemical, thermal and mechanical properties. Special interest has been paid to the BC_xN stoichiometry, understood as a substitution of BN atomic pairs by isoelectronic CC pairs that satisfies the charge neutrality condition expected for a stable ternary compound. However, the synthesis of B-C-N compounds in thin film form often produces a broad range of compositions far from BC_xN . Actually, several theoretical and experimental studies have pointed to the metastable character of B-C-N materials, a fact that is frequently translated into elemental and/or binary phase segregation. In this work, we present a detailed and systematic study of the X-ray absorption near edge structure (XANES) of B-C-N ternary compounds with $B_2C_xN_3$, BC_xN and B_2C_xN (0

On the one hand, the B-rich BCN compounds (B_2C_xN) showed clear signs of icosahedral BC_x -like and a-C phase segregation in a hexagonal B-C-N matrix, whilst N-rich samples ($B_2C_xN_3$) exhibited CN_x segregated phases. On the other hand, the spectral features of BC_xN layers could be correlated to a graphite-like B-C-N single ternary phase, with increasing number of structural defects for increasing nominal B/N impinging atomic fluxes.

In addition, it was found that BC_xN layers with low concentration of defects exhibited the best tribomechanical performance. Finally, self-hardening of these samples from ~ 2 GPa to ~ 18 GPa has been observed within a timespan of a few days of storage in air.

As a whole, a comprehensive discussion of the tribomechanical properties of B-C-N coatings with respect to their composition and bonding structure is provided.

Keywords

Thin films

Boron carbonitride

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Tribology