TOWARDS THE PRACTICAL APPLICATIONS OF CUBIC BORON NITRIDE FILMS

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Cubic boron nitride (cBN) with its zinc-blende lattice structure is isostructural and isoelectronic to diamond. It possesses similar properties like diamond and in some aspects has advantages over diamond. Unlike diamond it is chemically inert to ferrous materials at high temperature and for electronic applications it can be made with either n- or p-type conductivity. In spite of such extraordinary properties cBN films have not been used in practice so far. However, the recent progress in cBN film deposition suggests that the first implementation of cBN films into practice is just a step away. Therefore this presentation shows the achievements in synthesis of cBN films and elucidates them on the examples from our laboratory.

In contrast to the earlier difficulties in preparing films thicker than ~100 nm before their delamination the growth of well adherent cBN films with thickness larger than 2 μm became routine. Our measurement of hardness on cBN films in both the plain view and cross sectional view directions gives the reproducible hardness of 70 GPa which matches the value measured on cBN crystals synthesized by high-pressure high-temperature (HPHT) methods. Using fluorine chemistry and gases with highly energetic metastable states in a complex CVD environment enables to achieve crystalline faceted surfaces, which are practically void any hexagonal and/or amorphous boron nitride (hBN and/or aBN) phases. Similarly in the case of deposition on some substrates the widely reported interfacial aBN/hBN layers are regionally absent as well. Interestingly the particle energy/ momentum required for forming the cubic boron nitride phase was reduced down to a level corresponding to the –20 V bias. The experiments indicate that this bias voltage, being currently the lowest ever reported, may drop well below this value. Such synthesis employing interfacial engineering clearly shows the road towards the first implementation of cBN films into practice, for example, in cBN film deposition on tool materials via buffer layers. The presentation will elucidate and substantiate the most suitable buffer layers for such applications.