New functions in diamond and BN crystals obtained under high pressure

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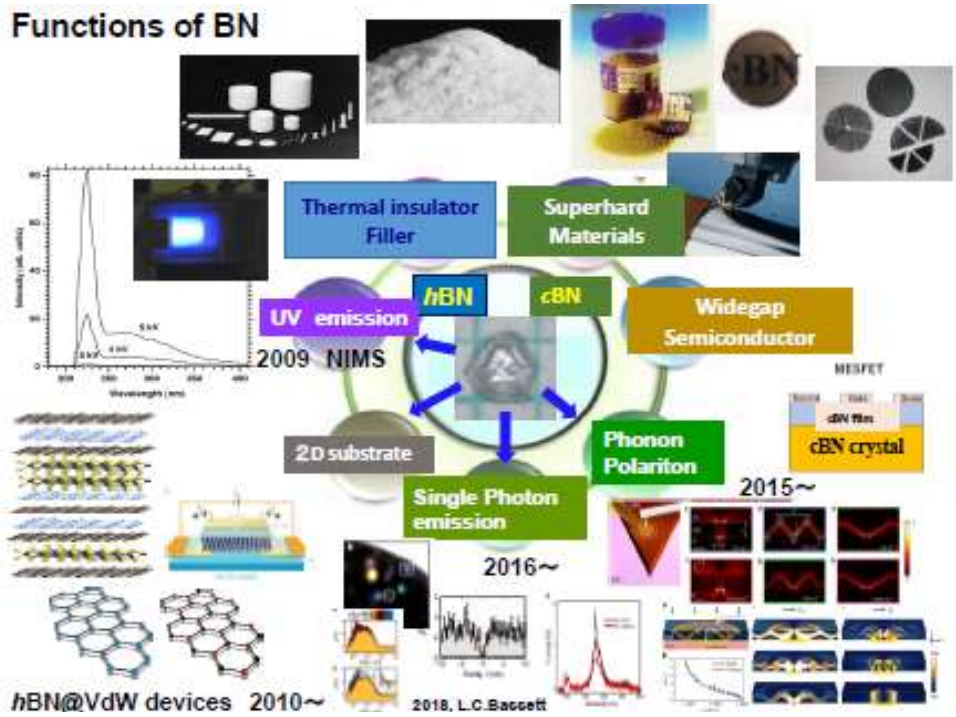
Abstract

Diamond and cubic boron nitride are known to be super-hard materials. Their single crystals and sintered bodies have been utilized as abrasives and cutting tools in industry. On the other hands, they have been also taken attention as wide-bandgap materials so far. Because of high melting temperature or decomposition, bulk single crystals growth can only be done by solvent growth process under high pressure. Now synthesis of high purity diamond single crystals with controlling their residual impurity levels less than a few ppm is now possible by optimize their growth condition such as P-T condition and solvent with some additives. Recently as a quantum material, diamond crystals with highly controlled nitrogen-related defects is an important subject for the research.

Some progresses in the synthesis of high purity BN crystals were achieved by using Ba-BN as a growth solvent material at high pressure (HP) of 5.5GPa [1]. Band-edge natures (cBN Eg=6.2eV and hBN Eg=6.4eV) were characterized by their optical properties. The key issue to obtain high purity crystals is to reduce oxygen and carbon contamination in the HP growth circumstances. Then an attractive potential of hBN as a deep ultraviolet (DUV) light emitter [2] and also superior properties as substrate of graphene devices [3] were realized. Also, controlling of boron and nitrogen isotope ratio (^{10}B, ^{11}B and ^{15}N) in hBN and cBN crystals can be now carried out by metathesis reaction under HPHT [4]. The newly developed functions can be realized by using high purity BN single crystals as shown in Fig.1.

In this paper, recent studies on impurity control for diamond and BN single crystals obtained at high pressure with respect to impurity / isotope controls and their functionalization will be reported.



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