Hard X-ray photoemission studies on heavily boron-doped superconducting diamond

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The recent discovery of superconductivity in heavily boron-doped diamond [1] has attracted much attention because of the mechanism of superconductivity as well as the normal-state electronic states that plays a crucial role for the superconductivity. While a lot of X-ray photoemission studies have been performed to observe surface and/or interface electronic structures of diamond samples with very low dopant concentrations, photoemission spectroscopy have not been reported for samples in the heavily boron-doped region. Thus, experimental investigations for the bulk electronic structures are indeed desirable to understand the physical properties of the heavily boron-doped diamond superconductor.

In the present study, we use hard X-ray photoemission spectroscopy (HXPES) of 8 keV to study the intrinsic boron concentration dependent core-level electronic states of heavily boron-doped diamond films from metallic non-superconducting samples to superconducting samples, made with a plasma assisted chemical vapor deposition technique. Since it is known that HXPES using a 8 keV photon energy can provide a photoelectron mean free path of as long as 70 Å for diamond, the obtained results reflect bulk electronic structures. The present HXPES results show a chemical shift of the C1s main peak and evolutions of additional features for C1s and B 1s core levels, which lead to deeper understanding of the evolutions of electronic structure and changes in chemical environments upon boron doping of heavily boron-doped superconducting diamond.

[1] E. A. Ekimov, V. A. Sidorov, E. D. Bauer, N. N. Mel'nik. N. J. Curro, J. D. Thompson, and S. M. Stishov, Nature (London) **428**, 542 (2004).