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Layer-by-layer Dielectric Breakdown of Hexagonal Boron Nitride Film in Conductive AFM Measurement YOSHIAKI HATTORI, The University of Tokyo, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, KOSUKE NAGASHIO, The University of Tokyo and PRESTO-JST — Hexagonal boron nitride (BN) is considered as ideal gate dielectric and substrate for graphene devises. However, many intrinsic properties of BN have not been clarified yet, since many researchers have focused on the electrical properties of graphene. In this study, the dielectric breakdown of BN is systematically studied using the conductive atomic force microscopy. The obtained dielectric field strength is $\sim$ 12 MV/cm, which is comparable to the conventional SiO_2. After the hard dielectric breakdown, BN fractured like a flower with equilateral triangle fragments. However, when applied voltage is stopped just in the middle of the dielectric breakdown, the formation of hole was clearly observed, which does not penetrate to the bottom metal electrode. Subsequent IV measurement at the hole indicates that the remaining BN layer in the hole is still electrically inactive. Based on these observation, the layer-by-layer breakdown is suggested for BN from the viewpoint of physical fracture and electrical breakdown. Moreover, the statistical analysis on breakdown voltages by Weibull plot suggests the anisotropic formation of defects. These results are unique to the layered materials, unlike the conventional 3D amorphous oxides.

Yoshiaki Hattori
The University of Tokyo

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