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Enhancement of carrier transport in black phosphorus through via contacts embedded in h-BN

Black phosphorus (BP), one of the allotropes of phosphorus, is a promising candidate for future nano-electronics and nano-photoelectronics. Unlike conventional two dimensional semiconducting materials which show n-type property and high electron mobility, BP shows p-type property and high hole mobility [1]. However, BP faces limitations in application to future electrical devices since BP is easily degraded in air atmosphere, and therefore attempts are made to prevent BP from being oxidized under air ambient. Here, we employed the via contact method [2] for suppressing degradation of BP. The method is to make direct electrical contact by using metal embedded hexagonal boron nitride (hBN) on BP which was not exposed to air. The fabricated devices showed enhanced carrier transport properties because of the suppressed degradation of BP. The devices also showed low contact resistance since ultraclean interface between metal and BP was formed. Furthermore, by applying forces on the contact interface between metal and BP by atomic force microscopy (AFM) probes, the electrical performance of the devices were enhanced, attributed to the better electrical contact formed between metal and BP.

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