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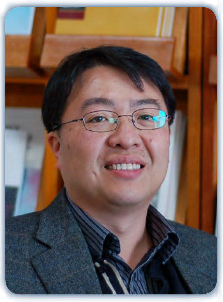

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Graphene/h-BN heterostructures based field effect transistors employing chemical vapor deposition grown h-BN as a dielectric layer

Hexagonal boron nitride (h-BN) has emerged as an exceptional dielectric material for graphene field effect transistors (GFETs). GFETs exploiting mechanically exfoliated h-BN dielectrics exhibited an order of magnitude improvement in device mobility, reduced carrier in-homogeneity, lower extrinsic doping, reduced chemical reactivity, and improved high-bias performance when compared with devices with conventional oxide dielectrics. Chemical vapor deposition (CVD) based growth of high-quality graphene and h-BN over a large-area is currently the most widely used. However, the CVD grown h-BN dielectric has not been demonstrated for high-performance GFETs. This is mainly due to problems associated with a contamination issue in a thin poly(methyl methacrylate) (PMMA) assisted transfer of CVD-grown 2D materials, such as graphene and h-BN, from a growth substrate to a target substrate for the optical and electronic devices fabrication. This limits further study of heterostructure of 2D materials using layer-by-layer transferring methods. In this work, we have developed a facile transfer technique for 2D materials by adding a water-soluble PVA layer in-between PMMA and 2D materials grown on the rigid substrate. This technique allows not only effective transfer to a target substrate with a high degree of freedom but also etching-free PMMA-assisted transfer while minimizing the effects of related contaminants on the material surface. GFETs transferred by this process exhibits a negative shift of charge neutrality point close to zero and both graphene and graphene/h-BN FETs showed greater mobility, higher current modulation and smaller hysteretic than GFETs that use PMMA assisted transfer due to the elimination of PMMA contaminants. Our results demonstrated that the developed transfer method is so versatile that multilayer stacking of heterostructure of graphene and h-BN materials, and wafer-scale transfer are reliably performed. This facile transfer technique presents great potential for future research and application for high performance, flexible and transparent in the large area of mechanical, optical and electronic devices based on graphene/h-BN heterostructures.

Biography

Following 20 years of extensive research experiences in solid-state physics and nanotechnology at UK and USA based universities, Prof. Kang moved to Sungkyunkwan University in 2005, one of the premier research oriented universities in Korea to take up a professorship. He has published more than 180 SCI peer-reviewed articles in the top journals including Nature Nanotechnology, Advanced Materials, Nano Letters, ACS Nano, Advanced Functional Materials and several book chapters in solid-state physics and nanotechnology areas covering from nanofabrication to materials synthesis and to device physics. The quality of his work can be easily indicated by Scopus H-index of 34 and the total citation of over 4000. He has served as an editorial board member for several internationally renowned scientific journals including IOP journal "Nanotechnology" since 2006 and as an Editor-in-Chief in Current Nanoscience since 2014. He has played a key role in several nation's most competitive research programs including Science Research Center, Priority Research Center and World Class University programs as a co-principle investigator, which proves his research excellency and professional competence. He has given numerous keynote and invited lectures in many renowned international conferences.

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