Recent Advances in Nanoenergy Harvester Utilizing Two Dimensional Materials

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ABSTRACT

Piezoelectric nanogenerator (PENG) is an alternative sustainable energy by transforming surrounding mechanical energy into electrical power. It is one of the green alternatives to reduce our dependence on non-renewable chemical energy such as batteries and save our environment from pollution. Its miniature size, low cost, ease of fabrication makes it applicable to ease the installation, integration, and implementation in current existing circuits, devices, and system and may find a potential application in electromechanical sensing, wearable technology and implanted devices. As the term of nanogenerator suggests, nanomaterials such as nanowires, nanoparticles, and nanoflakes are involved in fabricating this device. The high surface to volume ratio, particularly the composite of nanomaterials tends to develop the certain properties of nanogenerator.

The incorporation of two-dimensional materials such as graphene quantum dots (GQDs) and molybdenum disulphide (MoS2) as the nano-fillers in the electroactive materials is expected to enhance the power output by increment of the dielectric constant, induction of quantum confinement and edge effect. In addition, its fragments limited in size or domains of a single-layer two-dimensional layered structure with a large aspect ratio could form many parallel micro-capacitors within the piezoelectric materials. Our recent studies showed that there is a significant increase of voltage output when we incorporate GQDs and MoS2 nanofillers to the device and the output increased significantly. The two-dimensional materials play an importantrole in electron trapping and charge accumulation in enhancing the device piezoelectricity. Upon the interaction and intercalation between the MoS2/GQDs and PVDF polymer chains, a large amount trapped charges transferred to the electrodes of PENG and amplify the output voltage of the device. The fabricated optically transparent and mechanically flexible devices pave the way to realize the future next generation see through and flexible electronic gadgets especially energy harvesting, sensors, wearable devices, and various optoelectronics touch input gadgets.

BRIEF BIOGRAPHY

A ssoc. Prof. Dr. Mohd Ambri Mohamed is a Senior Research Fellow and Deputy Director at Institute of Microengineering and Nanoelectronics (IMEN), Universiti Kebangsaan Malaysia (The National University of Malaysia). Prior to joining UKM, he was an Assistant Professor at Department of Materials Engineering, Faculty of Engineering, International Islamic University Malaysia (IIUM) and served as Assistant Professor at Graduate School of Materials Science, J apan Advanced Institute of Science and Technology (JAIST), Japan.

He specializes in carbon materials devices and molecular beam epitaxial growth using MBE technique in which he developed carbon electronics laboratory in IMEN soon after his appointment with UKM. His current research interests are carbon materials and 2D materials synthesis and application in nanoelectronics.

He obtained his B. Eng (Materials Engineering) in 2004 from Tokyo University of Science, Japan. After working as engineer at Alps Electric, he pursued his postgraduate studies in Japan Advanced Institute of Science and Technology (JAIST), Japan and obtained MSc (Materials Science) in 2007 and PhD (Materials Science) in 2010. He spent 12 years to observe Japanese-based tertiary education and gained work experience in Japanese environment and returned to serve the country under TelentCorp Malaysia. He is a member of The Japan Society of Applied Physics, The Physical Society of Japan, IEEE, Malaysia Nanotechnology Association, The Microscopy Society Malaysia and Malaysia Solid State Science Technology Association (MASS).