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Graphene flake and graphene quantum dot-receptor sensor for detecting nerve agents

A novel gas sensor consisting of porous, non-stacked reduced graphene oxide (NSrGO)-heaxfluorohydoroxypropanyl benzene (HFHPB) nanosheets was successfully fabricated, allowing the detection of dimethyl methyl phosphonate (DMMP), similar to sarin toxic gas. The HFHPB group was chemically grafted to the NSrGO via a diazotization reaction to produce NSrGO-HFHPB. The NSrGO-HFHPB 3D film has a mesoporous structure with a large pore volume and high surface area that can sensitively detect DMMP and concurrently selectively signal the DMMP through the chemically-attached HFHPB. The DMMP uptake of the mesoporous NSrGO-HFHPB was 240.03 Hz, 12 times greater than that of rGO-HFHPB (20.14 Hz). In addition, the response rate of NSrGO-HFHPB was faster than that of rGO-HFHPB, an approximately 3 times more rapid recovery due to the mesoporous structure of the NSrGO-HFHPB. In addition we like to present a band gap tuning of environmental-friendly graphene quantum dot (GQD) for a photoluminescence (PL) sensor. With the help of the electron withdrawing HFHPB group, the energy band gap of the HFHPB-GQD was widened and its PL decay life time decreased. As designed, after addition of dimethyl methylphosphonate (DMMP), the PL intensity of HFHPB-GQD sensor sharply increased up to approximately 200% through a hydrogen bond with DMMP. The fast response and short recovery time was proven by quartz crystal microbalance (QCM) analysis. This HFHPB-GQD sensor shows highly sensitivity to DMMP in comparison with GQD sensor without HFHPB and graphene. In addition, the HFHPB-GQD sensor showed high selectivity only to the phosphonate functional group among many other analytes and also stable enough for real device applications. Thus, the tuning of the band gap of the photo-luminescent GQDs may open up new promising strategies for the molecular detection of target substrates.

Biography

Hyoyoung Lee completed his PhD in Department of Chemistry at University of Mississippi, USA in 1997. He held Post-doctoral Associate position at North Carolina State University, USA, for two years. He worked at Electronics and Telecommunications Research Institute from 2000 to 2009 as Team Leader. He moved to Sungkyunkwan University and has served as a Full Professor at Department of Chemistry, lecturing organic chemistry. He served as a Director of National Creative Research Initiatives, Center of Smart Molecular Memory from 2006 to February, 2015. Currently, he is serving as an Associate Director of Centre for Integrated Nanostructure Physics, Institute of Basic Science from November 2015. His current research area includes "Organic semiconducting materials and devices including molecular/organic memory, OLED, OTFT, sensors, energy harvesting and storage, graphene oxide, reduced graphene oxide, and 2D transition metal chalcogenide". He has written more than 120 journal articles with top-tier journals.

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