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Graphene Sensors for Healthcare Applications

Rapid detection of low concentration of specific analytes in small sample volumes is critical in early point-of-care diagnosis. Graphene's unique electron transport properties and large surface area due to its atom-thick 2D structure makes it a promising candidate for biosensors. Recently, the graphene sensor technology promise to be a vision technology in next generation electronics and sensors - due to graphene's exceptional electronic properties and aptitude for chemical modification. Graphene based biosensors have been developed, based on chemically functionalised graphene microchannels using wide range of graphene such as epitaxial graphene, screen printed graphene sensors and on CVD graphene. Several different chemical functionalisation methods for graphene have been evaluated and used in sensing applications of graphene, electrochemical and CHEMFET sensors. Direct and indirect (using a modification of an adsorbed layer or polymer film on top of the graphene) functionalisation techniques including diazotisation, aminosilane chemistry and non-covalent functionalisation methods were developed and reviewed. The chemical functionalisation plays a significant role in dictating the sensitivity of the device by improving the attachment of "bioreceptor" molecules, capable of specific and selective detection of target biomarkers. The technology is now being applied to detect blood based biomarkers related to Alzeimers Disease. Changes in the current-voltage characteristics of the graphene sensors are used to detect proteins.

Biography

Owen J Guy (OJG), is Director of the Centre for Nanohealth in the College of Engineering at Swansea University; a unique facility applying device fabrication & cleanroom semiconductor processing to healthcare problems in collaboration with industry. OJG is also head of the Systems Process & Engineering Centre (SPEC) one of 3 research centres within Swansea's College of Engineering. OJG's group has 14 years' experience in clean room device fabrication (silicon, graphene & MEMS technology). OJG developed the world's first epitaxial graphene biosensors in 2010 for detection of a cancer risk marker, through successful EPSRC project (EP/I00193X/1)[O. Guy et al., 2D Materials 1 (2014) 025004; Sensors and Actuators B: Chemical, 2014. 190(0): p. 723-729; J. Mater. Chem. B, 2014, doi: 10.1039/C3TB21235A, Patents (WO2011004136 A1) and (P100072GB)]. OJG is also pioneering integration of biosensor chips, based on active nanostructure transducers, with microfluidics EP/M006301/1. Guy has also developed silicon microneedle (MN) and microfluidics technology through EPSRC (EP/G061882/1, EP/L020734/1 & EP/I00193X/1, EP/N013506/1), KTP (KTP007901), & TSB / Innovate UK projects (101498). OJG has successfully supervised several more than 15 PhD and MSc students. OJG has vast experience of industrial collaboration under KTP and Innovate UK (TSB) projects, and has PI grant income of more than £5 million and a further £5 million as Co-I. OJG has published 60 papers, holds 2 patents (WO2011004136 and P100072GB), and was one of six candidates shortlisted for the Royal Academy of Engineering 2009 young entrepreneur award.

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