REPORT

Report on participation of the ICMR International Fellow (ICMR-IF) in Training/Research abroad

1. Name and designation of ICMR-IF: Dr. Rajesh

2. Address: CSIR-National Physical Laboratory, Dr. K.S. Krishnan Road, New Delhi-110012

3. Frontline area of research in which training/research was carried out:

   "Next generation concepts in chemical detection based on nano/bio hybrid structure for biomedical research"

4. Name & address of Professor and host institute:
   Prof. A.T Charlie Johnson,
   Director & Professor, Nano/Bio Interface Center (NBIC)
   Department of Physics, University of Pennsylvania, Philadelphia, PA, USA

5. Duration of fellowship: 22.12.2014 to 21.6.2015 (6 months)

6. Highlights of work conducted:

   (i) Technical expertise acquired:

   Microfabrication of gold electrodes patterns separated by 10 micro meter spacing on silicon wafer for making field-effect-transistors with conducting graphene channel by standard lithography procedure and its subsequent functionalization with disease specific antibody protein fraction for the quantitative detection of biomarkers of chronic diseases.

   (ii) Research results, including any paper

   High quality conducting graphene monolayer sheet was prepared using chemical vapor deposition (CVD) technique and successfully transferred over micro-fabricate gold electrodes pattern on SiO_2/Si wafer and developed using standard lithography process to construct 52 graphene-field effect transistors (G-FET devices) in a chip. Graphene in G-FET devices were modified with platinum nanoparticles to nanohybrid structure for the self-assembled attachment of thiol containing disease specific genetically modified anti-body single chain variable

fragment (ScFv) protein for the fabrication of Bio-G-FET devices. The physical and electrical characterization of the Bio-FET devices were carried out by various instrumentation techniques such as scanning electron microscopy, atomic force microscopy, transmission electron microscopy, Raman spectroscopy, and gate-field effect studies, respectively. As-a-proof of concept, the electrical sensing performance of the Bio-FET was carried towards the detection of breast cancer biomarker, HER3, in PBS. The Bio-FET showed an antigen, HER3, concentration dependent response over a wide range of concentration from 0.3 ng mL^{-1} to 300 ng mL^{-1} that was in quantitative agreement with a model based on the Hill–Langmuir equation of equilibrium thermodynamics. Based on above Bio-GFET sensing performance, we may conclude that this platform of nano-hybrid graphene structure can also be used for the detection of other biomarkers of chronic diseases such as "Troponin I" in cardiovascular diseases.
(A research article based on above experimental results is under preparation)

(iii) Proposed utilization of the experience in India

The technical experience gained during my training abroad will be utilized in my on-going research activity on "Fabrication and electrical characterization of nanohybrid biosensors" for the diagnosis of chronic diseases.

Signature of ICMR-IF

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