Astonishing sensing potential of carbon nanotubes and graphene illustrated by in situ sensor refreshing

Gugang Chen and Avetik R. Harutyunyan
Honda Research Institute USA Inc.
1381 Kinnear Road, Columbus, OH 43212, USA

Single-walled carbon nanotube (SWNT) and graphene are potential candidates for the ultimate sensors since both SWNT and graphene consist solely of surface so that every single carbon atom is in direct contact with the environment and therefore allows optimal interaction with nearby molecules. Ironically their ultrahigh sensitivity is easily compromised by contaminants from the ambient environment. Here we illustrate a delicate way to minimize this problem. Through dynamical refreshing of the sensor surface with continuous *in situ* UV light illumination during the course of detection, we have observed 2 to 4 orders of magnitude better sensitivity than current state-of-the-art results for a range of gas molecules, and for the first time entered parts-per-quadrillion (PPQ) detection level at room temperature [1, 2]. The concept of *in situ* sensor refreshing can be utilized to exploit the intrinsic sensitivities of other nanomaterials. In addition, we demonstrate how a gate bias introduced on a semiconducting-SWNT device may help to achieve gas selectivity.

References

[1] G. Chen, T. M. Paronyan, E. M. Pigos, and A. R. Harutyunyan, Scientific Reports **2**, 343 (2012).
[2] G. Chen, T. M. Paronyan, and A. R. Harutyunyan, Appl. Phys. Lett. **101**, 053119 (2012)