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Graphene nano-electro-mechanical (NEM) devices for advanced applications

HIROSHI MIZUTA[1,3,*], MAREK E. SCHMIDT[1], SHINICHI OGAWA[2] AND MANOHARAN MURUGANATHAN[1]

[1]*Graduate School of Advanced Science and Technology, Japan Advanced Institute of Science and Technology (JAIST), Nomi, Ishikawa, 923-1292, Japan*
[2]*National Institute of Advanced Industrial Science and Technology (AIST), Japan*
[3]*Hitachi Cambridge Laboratory, Hitachi Europe Ltd., Cambridge, UK*
*e-mail: mizuta@jaist.ac.jp

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Graphene possesses remarkable electronic and mechanical properties and provides a promising platform to explore future nano-electro-mechanical (NEM) devices for challenging applications. Novel graphene NEM (GNEM) devices are first presented, which achieve room temperature sub-thermal switching (S < 60 mV/dec) with low switching voltage. A GNEM chemical gas sensor is then presented (Fig. 1), which features a slanted graphene channel with built-in tensile strain. By applying substrate bias to accelerate the CO_2 molecule adsorption, we show 'quantized' increments in the temporal resistance ΔR, which signifies single molecule adsorption / desorption[1)].

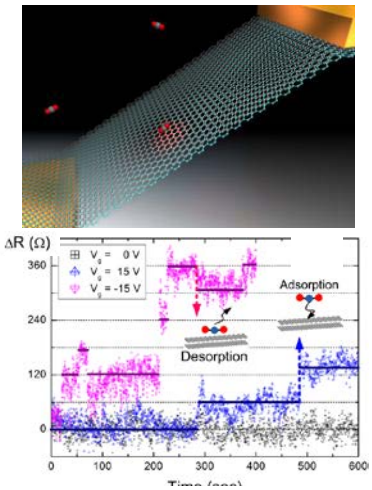

Fig.1 GNEM single CO_2 molecular sensor

We then show our recent attempt of patterning single-nanometer-size nanopores in suspended graphene by using atomic-size focused helium ion beam. Arrays of pores of 3 – 4 nm in diameter spanning a suspended ribbon were successfully patterned. Thanks to a very high Young's modulus and ta high Debye temperature of graphene, the phononic bandgaps are expected to be formed in the bandwidth of a few THz. This will enable us to control thermal transport dominated by heat phonons for relatively low temperature (< 200°C).

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Reference

1) J. Sun, M. Muruganathan, and H. Mizuta, Science Advances 2: e1501518 (2016)