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Solution-gated graphene field-effect transistors as local pH sensors in microfluidic systems WAN LI, Department of Physics, Cornell University, HÉCTOR D. ABRUÑA, Department of Chemistry and Chemical Biology, Cornell University, DANIEL C. RALPH, Department of Physics, Cornell University — We report a study of solution-gated graphene field-effect transistors (SGGFETs) as high-performance local pH sensors in microfluidic devices. Previous experiments have shown that SGGFETs can function as pH sensors for bulk volumes of solutions, and a response of 20 mV/(unit pH) shift in the Dirac point was typically observed. In our study, we investigated SGGFETs micro-fabricated out of CVD graphene grown on copper foil and found a robust pH sensitivity of 50 mV/(unit pH). This value is close to the thermodynamically allowed maximum value, i.e., the Nernst value of 59 mV/(unit pH) at room temperature. We further integrated the SGGFETs into microfluidic systems for lab-on-chip applications. We found the SGGFETs are capable of real-time detection of local pH changes in microfluidic channels, thus providing reliable measurement of the local pH for small volumes of liquids (a few nL). Possible applications of this microfluidic detection system, for example, in monitoring chemical diffusion and reactions in microfluidic channels, will be discussed.

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