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Electrochemistry of Graphene Edge Embedded Nanopores SHOUVIK BANERJEE, JIWOOK SHIM, JOSE RIVERA, XIAOZHONG JIN, DAVID ESTRADA, VITA SOLOVYEVA, XIUQUE YOU, JAMES PAK, ERIC POP, NARAYANA ALURU, RASHID BASHIR, University of Illinois at Urbana Champaign — We demonstrate a stacked graphene- Al_2O_3 dielectric nanopore architecture to investigate electrochemical activity at graphene edges. It has proven to be difficult to isolate electrochemical activity at the graphene edges from those at the basal planes [1]. We use 24 nm of Al_2O_3 to isolate the graphene basal planes from an ionic fluid environment. Nanopores ranging from 5 to 20 nm are formed by an electron beam sculpting process to expose graphene edges. Electrochemical measurements at isolated graphene edges show current densities as high as 1.2 x 10^4 A/cm^2, 300x greater than those reported for carbon nanotubes [2]. Additionally, we modulate nanopore conductance by tuning the graphene edge electrochemical current as a function of the applied bias on the embedded graphene electrode. Our results indicate that electrochemical devices based on graphene nanopores have promising applications as sensitive chemical and biological sensors, energy storage devices, and DNA sequencing.

[1] Ambrosi, *et al.*, Nanoscale **3**, 2256 (2011);
[2] J. Britto, *et al.*, Adv. Mater. **11**, 154 (1999)

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