Bioelectronics Applications with Nanostructures

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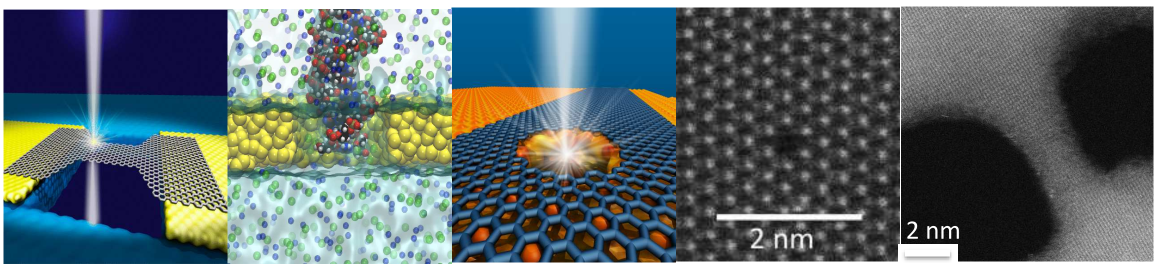
I will describe experiments that push the limits of nanoelectronics device size to atomic scale in thin materials and expand their function and precision. Experiments include fabrication of nanoribbons and field-effect-transistors from novel two-dimensional materials down to sub-nm widths and the ultrafast, all-electronic detection and analysis of biomolecules with nanopores. As molecules are driven through nanopores in solution, they block the ion current flow resulting in current reductions from which molecule's physical and chemical properties are inferred. DNA, proteins and other biomolecules can be analyzed. The temporal, spatial resolution and sensitivity in these experiments have been improved over the last few years thanks to advanced materials, device designs and new electronics.



From left to right: Illustrations of nanoribbon sculpting with the electron beam; passage of a DNA molecule through a nanopore; illustration of nanopore drilling with an electron beam inside of the TEM; one-atom-large nanopore in a MoS_2 sheet; armchair phosphorene nanoribbon sculpted in the AC-TEM.

References: G. Danda, *ACS Nano* 11 (2), 1937, 2017; Rodriguez-Manzo *et al.*, *ACS Nano* 10 (4), 4004, 2016 & *ACS Nano* 9 (6), 6555, 2015; Qi *et al., ACS Nano* 9(4), 3510, 2015; Balan *et al.*, *Nano Letters* 14 (12), 7215, 2015; Drndic, *Nature Nanotechnology* 9, 743, 2014.