

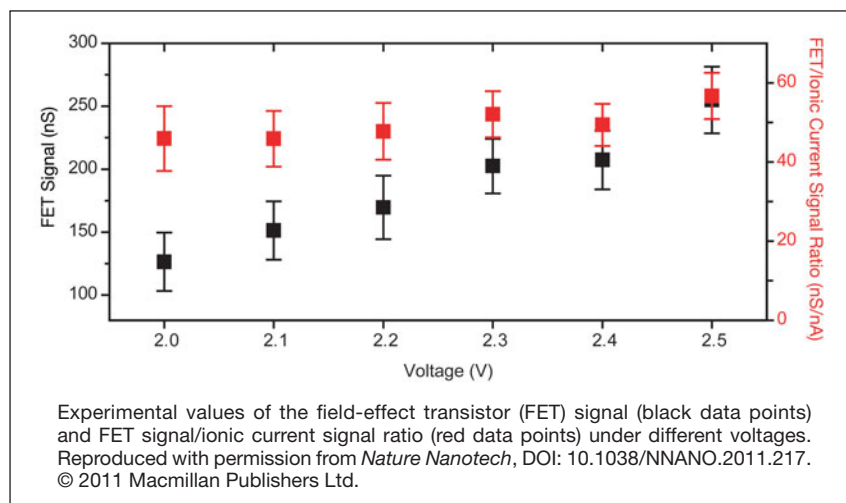


## Nano Focus

**Silicon nanowire FET-integrated nanopore sensor uses local electrical potential detection as a novel method for DNA sequencing**

Current nanopore technologies for direct DNA sequencing are limited in their detection sensitivity by the fast translocation speed of DNA molecules ( $\sim 1 \mu\text{s base}^{-1}$ ). An international research group led by Charles M. Lieber of Harvard University has developed a silicon nanowire field-effect transistor-integrated nanopore sensor to tackle the challenge of providing high bandwidth detection to match the fast DNA translocation speeds. The novel nanowire-nanopore sensor exploits the localized electrical potential developed near the nanopore during DNA translocation, to provide a highly sensitive DNA sequencing method. Lieber, P. Xie, and Q. Qing of Harvard; Q. Xiong of Nanyang Technological University in Singapore; and Y. Fang of the National Center for Nanoscience and Technology in China published their findings in the December 11, 2011 issue of *Nature Nanotechnology* (DOI: 10.1038/NNANO.2011.217).

Chemical vapor deposition (CVD)-synthesized *p*-type silicon nanowires were deposited onto  $\text{SiN}_x$  membranes,



with nickel contacts defined by electron-beam lithography. The nanopores were drilled with a focused electron beam in a transmission electron microscope. The FET-integrated sensor is electrically connected to a printed circuit board chip carrier, which in turn is sandwiched between two poly(dimethylsiloxane) (PDMS) solution chambers with buffer solutions. The double strand DNA molecule is then injected into the bottom PDMS chamber to translocate through the nanopore. However, the researchers had to change the relative ionic strengths of the top and bottom PDMS chambers, with the bottom chamber having a higher ionic strength, in order to successfully produce the localized potential and de-

tect FET conductance signals correlated in time to the ionic currents.

The researchers report a constant ratio between the orders of magnitude larger FET signal and corresponding ionic current signal. Such a correlation is a unique advantage of this new sensing method. This feature in principle ensures the compatibility of this much faster sensing scheme with all previous ionic current-based nanopore base-differentiation methods. Furthermore, the FET-integrated nanopore sensors have the potential to be integrated and multiplexed into large-scale DNA detection systems for higher throughput without complex microfluidics.

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## Nano Focus

**Functional ferroelectric tunnel-junction memories demonstrated**

Quantum mechanical tunneling across an insulating barrier is the basis for the operation of magnetic tunnel junctions and other novel memories. However, current memory designs are hampered by poor resistance switching ratios and high power consumption. This problem could potentially be overcome by use of a ferroelectric tunnel barrier material which promises high OFF/ON resistance ratios with lower power consumption. Meeting this challenge, an international research group has recently described the

design of a ferroelectric tunnel junction with exceptional tunneling electroresistance that may compete with traditional nonvolatile memories. A. Chanthbouala of the Unité Mixte de Physique CNRS/Thales, S. Fusil of CNRS and the Université d'Evry-Val d'Essonne, X. Moya of the University of Cambridge, S. Xavier of Thales Research and Technology, A. Moshar of Asylum Research in Santa Barbara, and their colleagues have reported their findings in the December 4, 2011 online

