tively large, which can be attributed to the well-ordered nature of the system, according to the researchers. Contact-angle hysteresis is due to the fact that the contact angle of water advancing on a structured surface can be different than the contact angle of water receding on the same surface.

EKATERINA A. LITVINOVA

Molecules Self-Assembled on Nanowire FETs Serve as Multilevel Memory Element

With Si-based memory technologies reaching their physical and technical limitations, researchers have focused on molecular memory devices in order to overcome these limitations. Such devices employ a method of storing charges at discrete reduction and oxidation states of molecules, with the possibility of storing multiple bits per cell. Due to the extremely small size of such technologies on the order of single molecules and the ability to self-assemble the molecular layers, this method could lead to extremely high-density storage devices far beyond the capabilities of Si-based memories. In the March 15 issue of *Applied Physics Letters*, C. Li and C. Zhou of the University of Southern California, W. Fan of NASA Ames Research Center, and their colleagues have reported the development of multilevel molecular memory devices for storing up to three bits (eight levels) per cell. The device features a retention time of up to 25 days, which is much larger than in other molecular memory devices, and is realized based on nanowire field-effect transistors with self-assembled redox active molecules.

The basis of the device is semiconducting nanowire field effect transistors (FETs). Pulsed laser ablation was used to synthesize n-type In_2O_3 nanowires. The nanowires, which were 10 nm in diameter, were then deposited onto a wafer consisting of silicon covered by 100 nm of silicon dioxide. Source and drain electrodes were then patterned to form the FET. Finally, the nanowires were functionalized by immersing them in 0.5 mM solutions of a molecule, which formed a monolayer onto the nanowire by self assembly. The 2 nm monolayer thickness of the self-assembled molecular layer was verified by ellipsometry.

The researchers studied different redox molecules, such as Fe-terpyridine, that varied either in metal ion (Fe^{2+} and Co^{2+}) or in the counter ion (Cl^- or PF_6^-). Writing and reading operations were accomplished by using gate voltage pulses and current sensing, respectively. The device can store multiple bits within the same single memory cell, instead of relying on storing single bits per unit. Such techniques have received increasingly more attention from semiconductor industry in recent years.

The research team estimated that the device features an extremely high storage density of 40 Gbits/cm^2. An important advantage from the viewpoint of semiconductor processing is that the manufacture of this device is simpler than that of the classical silicon flash memory, since it involves only one step of photolithography and metallization. The new device also has strong advantages with respect to power consumption compared to silicon technology. The researchers propose that recent advances in nanowire assembling could be utilized to generate memory arrays.

MARKUS J. BUEHLER

FOR MORE RESEARCH NEWS ON MATERIALS SCIENCE . . .
. . . access the Materials Research Society Web site:
www.mrs.org/gateway/matl_news.html

https://doi.org/10.1557/mrs2004.71 Published online by Cambridge University Press