Korean researchers report creation of faster, more resilient ReRam

July 20 2011, by Bob Yirka

(PhysOrg.com) -- Korean researchers working out of the Samsung Advanced Institute of Technology report in a paper published in *Nature Materials*, that they've been able to create a non-volatile Resistance RAM (ReRam) chip capable of withstanding a trillion read/write cycles, all with a switching time of just 10ns (about a million times faster than current flash chips), paving the way for a possible upgrade to flash memory cards.

ReRam chips are non-volatile, meaning they can retain stored information in the absence of power and are currently made using a Ta_2O_5 (tantalum) film, the new chips developed by the Samsung team uses T_a2O_{5-x}/TaO_{2-x} as filaments to create a bi-layer structure, rather than coating the entire surface with the metallic substance.

The authors report in the paper that they believe their chip uses less power than other experimental ReRam chips and should be suitable as a potential replacement for current flash memory devices.

The research is part of the IMEC consortium comprised of some of the biggest names in chip research; in addition to Samsung, other participants include Intel, Panasonic, NVIDIA and many others. The ultimate goal is to seek out new frontiers in the advancement of nano-electronics.

Resistive random access memory is based on the idea of a dielectric, which is a substance that is normally insulating, but when jolted with sufficient power, becomes a conductor. It's this property that allows information to get in and then to be held inside after the power is removed; sort of like pushing an object through a rubber gasket, it takes force to get both in and out. To use the substance in a memory chip, a path must be maintained though it in both directions and that is what the metallic filaments are for, to carry signals through the dielectric substance. The filaments are then gated, which means the path through can be broken and unbroken to allow current to pass through or not. In this new research, many filaments, or paths, are created to increase the amount of information that can come and go with any one jolt of electricity.

The only down side to the new research is that it appears it won't be ready to go to market for a while, as more research is needed. In the meantime, we'll all just have to be careful with how much reading and writing we do with our flash drives.

More information: A fast, high-endurance and scalable non-volatile memory device made from asymmetric Ta2O5−x/TaO2−x bilayer structures, *Nature Materials* (2011) doi:10.1038/nmat3070

Abstract
Numerous candidates attempting to replace Si-based flash memory have failed for a variety of reasons over the years. Oxide-based resistance memory and the related memristor have succeeded in surpassing the specifications for a number of device requirements. However, a material or device structure that satisfies high-density, switching-speed, endurance, retention and most importantly power-consumption criteria has yet to be announced. In this work we demonstrate a TaOx-based asymmetric passive switching device with which we were able to localize resistance switching and satisfy all aforementioned requirements. In particular, the reduction of switching current drastically reduces power consumption and results in extreme cycling endurances of over 1012.

Along with the 10 ns switching times, this allows for possible applications to the working-memory space as well. Furthermore, by combining two such devices each with an intrinsic Schottky barrier we eliminate any need for a discrete transistor or diode in solving issues of stray leakage current paths in high-density crossbar arrays.

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