Breakthrough in memory technologies could bring faster computing, smaller memory device

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Memory devices like disk drives, flash drives and RAM play an important role in our lives. They are an essential component of our computers, phones, electronic appliances and cars. Yet current memory devices have significant drawbacks: dynamic RAM memory has to be refreshed periodically, static RAM data is lost when the power is off, flash memory lacks speed, and all existing memory technologies are challenged when it comes to miniaturization.

Increasingly, memory devices are a bottleneck limiting performance. In order to achieve a substantial improvement in computation speed, scientists are racing to develop smaller and denser memory devices that operate with high speed and low power consumption.

Prof. Yossi Paltiel and research student Oren Ben-Dor at the Hebrew University of Jerusalem's Harvey M. Krueger Family Center for Nanoscience and Nanotechnology, together with researchers from the Weizmann Institute of Science, have developed a simple magnetization progress that, by eliminating the need for permanent magnets in memory devices, opens the door to many technological applications.

The research deals with the flow properties of electron charge carriers in memory devices. According to quantum mechanics, in addition to their electrical charge, electrons also have a degree of internal freedom called spin, which gives them their magnetic properties. The new technique,

called magnetless spin memory (MSM), drives a current through chiral material (a kind of abundantly available organic molecule) and selectively transfers electrons to magnetize nano magnetic layers or nano particles. With this technique, the researchers showed it is possible to create a magnetic-based memory device that does not require a permanent magnet, and which could allow for the miniaturization of memory bits down to a single nanoparticle.

The potential benefits of magnetless spin memory are many. The technology has the potential to overcome the limitations of other magnetic-based memory technologies, and could make it possible to create inexpensive, high-density universal memory-on-chip devices that require much less power than existing technologies. Compatible with integrated circuit manufacturing techniques, it could allow for inexpensive, high density universal memory-on-chip production.

According to the Hebrew University's Prof. Paltiel, "Now that proof-of-concept devices have been designed and tested, magnetless spin memory has the potential to become the basis of a whole new generation of faster, smaller and less expensive memory technologies."

The technology transfer companies of the Hebrew University (Yissum) and the Weizmann Institute of Science (Yeda) are working to promote the realization of this technology, by licensing its use and raising funds for further development and commercialization. With many possible applications, it has already attracted the attention of start-up funds.

More information: Mathew, S., Naaman, R. A chiral-based magnetic memory device without a permanent magnet, *Nature Communications*. www.nature.com/ncomms/2013/130 … /abs/ncomms3256.html