

# The clear future of electronics

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A group of scientists at Korea Advanced Institute of Science and Technology (KAIST) has fabricated a working computer chip that is almost completely clear -- the first of its kind. The new technology, called transparent resistive random access memory (TRRAM), is described in this week's issue of the journal *Applied Physics Letters*.

The new chip is similar in type to an existing technology known as complementary metal-oxide semiconductor (CMOS) memory -- common commercial chips that provide the data storage for USB flash drives and other devices. Like CMOS devices, the new chip provides "non-volatile" memory, meaning that it stores digital information without losing data when it is powered off. Unlike CMOS devices, however, the new TRRAM chip is almost completely clear.

Why is transparency important? Clear electronics may make your room or wall more spacious by allowing electronic devices to be consolidated and stacked in small clear spaces. The technology may also enable the development of clear computer monitors and televisions that are imbedded inside glass or transparent plastic. The Korean team is also developing a TRRAM using flexible materials.

"It is a new milestone of transparent electronic systems," says researcher Jung Won Seo, who is the first author on the paper. "By integrating TRRAM device with other transparent electronic components, we can create a total see-through embedded electronic system."

Technically, TRRAM device rely upon an existing technology known as resistive random access memory (RRAM), which is already in commercial development for future electronic data storage devices. RRAM is built using metal oxide materials, which are very transparent. What the Korean team did was to build a chip by sandwiching these metal oxide materials between equally transparent electrodes and substrates.

According to the Korean team, TRRAM devices

are easy to fabricate and may be commercially available in just 3-4 years. Don't expect them to replace existing CMOS devices, however. Instead, Seo predicts, the new transparent devices will drive electronics in new directions.

"We are sure that TRRAM will become one of alternative devices to current CMOS-based flash memory in the near future after its reliability is proven and once any manufacturing issues are solved," says Professor Jae-Woo Park, who is Seo's co-advisor and co-author on the paper. He adds that the new devices have the potential to be manufactured cheaply because any transparent materials can be utilized as substrate and electrode. They also may not require incorporating rare elements such as Indium.

The article "Transparent resistive random access memory and its characteristics for nonvolatile resistive switching" by Jung Won Seo, Jae-Woo Park, Keong Su Lim, Ji-Hwan Yang and Sang Jung Kang was published on December 3, 2008 in *Appl. Phys. Lett.* (Volume 93, Issue 22). The article is available at [link.aip.org/link/?APPLAB/93/223505/1](http://link.aip.org/link/?APPLAB/93/223505/1)

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