Scientists Invent High-speed Digital Memory Device Using Commodity Plastics Transformed by Nanotechnology

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A team of scientists at UCLA has developed and built a plastic, non-volatile memory device using solution processing. In a paper appearing Nov. 28 online in the journal *Nature Materials*, the researchers outline how they designed a new type of polymer, or plastic, memory device. The research group, led by materials science professor Yang Yang in the UCLA Henry Samueli School of Engineering and Applied Science, has demonstrated high performance of plastic memory devices fabricated by solution processing. **The device is made from a polystyrene film containing gold nanoparticles**, and holds promise for low-cost, high-density memory storage.

"There is a lot of talk about nanotechnology, but our device is a nanoparticle-induced phenomenon. It is the nano size of the gold particles that allows them to store the charge and function as a memory device," Yang said. "It's a revolutionary technology. We've combined a traditional material — polystyrene — and a high-tech material to make it happen."

He added, "Polystyrene is a commonly used plastic material that can be found in the home, the office, the local grocery store and the cafeteria. It comes in many shapes and forms, from foam egg cartons to trays or soup bowls to coffee cups and utensils. And our invention turns this commodity plastics into a high-tech invention."

Yang's first-generation organic memory devices were fabricated in a vacuum chamber; his team wanted to develop a memory device that could be processed more easily. Although polystyrene may seem like an unlikely base material for memory devices, it's inexpensive and easy to work with.

In a solution process, the polystyrene base is carried in a liquid and can be applied through spray, paint or print technology. This method is less complicated than vacuum fabrication methods and also less expensive. Through the use of the solution process, the polystyrene-based material also can be constructed in three-dimensional arrays for high-density storage.

The new material has a wide range of potential uses, including digital memory chips for computers, digital cameras and cell phones, to name a few applications.

"There is a growing demand for inexpensive memory storage, and flash memory is expensive and slow," Yang said. "Plastic memory devices will be both faster and cheaper than current technology."

In laboratory tests, the polymer memory device has shown it can meet nearly all of the performance requirements. The team is working to extend its lifetime, so that it can write and erase for a million cycles and store the data for at least 10 years.

"We're exploring related scientific issues through materials engineering and a fundamental understanding of the device's operating mechanism to push it to the next level of reliability," Yang said. "By partnering with industry, we're also able to work on practical, commercial issues."

"This is one of the ways in which I think nanotechnology leads to a bright future in scientific exploration," Yang said. "Researchers must

create novel phenomena based on new materials and by finding new applications."

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Source: UCLA