Nano World: Nanomagnets in chips, antenna

Magnetic particles only nanometers or billionths of a meter wide promise to help electronics continue to pack ever closer together for more powerful microchips and other devices, experts told UPI's Nano World.

These nanoparticles could help shrink the magnetic elements in electronics by ten-fold or more, explained William Crossman, chief operating officer of Embedded Nanomagnetics in Farmington, Conn. The company, which is getting spun out from nanomaterials firm Inframat within the next month, already has strategic partnerships based on its nanotechnology enhanced magnetic elements with an electronics industry giant, a leading cell phone manufacturer, and two head aerospace defense contractors, he added.

The potential market for these novel magnetic elements "is in the billions of dollars," Crossman said.

Computers have steadily advanced in power for decades, with the microchip industry doubling transistor density every two years for the last 30 years, a trend dubbed Moore's Law after Intel cofounder Gordon Moore.

"The problem is magnetic elements, which are in virtually all electronics, have not obeyed Moore's Law, reducing the ability to shrink electronics. The magnetics are often the biggest, heaviest, clunkiest, hottest, least efficient pieces in electronics," Crossman said.

The "secret sauce" of the company's technology is made of magnetic particles 20 to 50 nanometers in diameter packed in an insulating polymer matrix, developed over roughly six years by Inframat with $6 million in funding from a combination of government sources, including the National Science Foundation, the U.S. Air Force and NASA.

The polymer matrix helps keep the nanoparticles from clumping, while at the same time keeping them close enough together at roughly 25 nanometers distance for a quantum effect called exchange coupling to occur. This helps the magnetic fields of the nanoparticles align, resulting in more efficient magnets.

Magnetic nanomaterials could "have tremendous impact on all electronic applications -- computing, wireless, defense, space and biomedical related," said materials engineer P. Markondeya Raj at the Georgia Institute of Technology in Atlanta. "The new magnetic nanomaterials developed by Inframat enable smaller components," he added, that can now be integrated easily into devices instead of manufacturing them separately and mounting them, "leading to bulky and low performance systems of today."

Using their initial nickel zinc ferrite magnetic nanoparticle-based paste, due to come out in six months to a year, "you can reduce the size and weight of magnetic elements in electronics by one-seventh to one-tenth of a conventional magnetic element and have equivalent effectiveness and greater efficiency," Crossman said.

Cobalt silicate nanoparticle-based thin films the company is developing could potentially have 100-fold improvement over conventional magnetics, Crossman added. The company anticipates one or more licenses on their technology within the next 24 months.