QSI-Nano™ Science Chat

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A World of Possibility for Nanomagnets

Whether aware of it or not, magnets are part of our everyday lives. Our driver's license, credit, and ATM cards have a magnetic stripe containing iron particles in a plastic film that is encoded with information. VHS tapes, audio cassettes, and floppy disks operate in the same manner. Electric motors and generators also employ magnets. We are all under the presence of the Earth's magnetic field all the time, and take advantage of this fact every time we use a compass. The tiny magnet in the compass interacts with the Earth's magnetic field to give us a directional reading.

Simply put, magnetism is a force associated with the movement of electrons in a particular substance.Permanent magnets (also known as *ferromagnets*) exhibit spontaneous magnetization. Metals such as iron, nickel, and cobalt are some of the best permanent magnets. These elements (as well as many others) can also behave *electromagnetically*, where they produce a magnetic field when an electric current is applied.

While bulk metals have shown great utility in magnetic applications, magnets based on nanometal particles are shown to provide additional advantages. For example, researchers at Cornell University have demonstrated the use of nano-sized cobalt particles as a way of producing a micro-computer data system capable of storing up to 100 times as much information as conventional magnetic disks. Unlike current RAM in today's computers, which needs a constant supply of electricity, magnetic RAM (MRAM) stores data using nanomagnets, such that information remains even when the chips are not powered. It may be possible to obtain even greater storage using QSI-Nano™ cobalt, having a particle size of about 10 nm.

Another application of interest is electromagnetic shielding, in which magnetic metal particles can be introduced into a plastic to make a coating. The weight or thickness of this coating can be significantly reduced employing more efficient metal nanoparticle magnets. These particles form a layer which can block radio waves, visible light, or electrostatic fields. These coatings are currently employed to isolate coaxial cables. Microelectromechanical systems (MEMS) can also benefit from nanomagnets for high speed, high bandwidth computing via tiny magnetic switches. These microdevices will have the power of larger arrays at a fraction of the size.

Researchers around the globe view nanomagnetic particles as a contending technology in the battle against cancer. If these particles are injected directly into the target area, and a magnetic field is applied, the heat generated may be sufficient enough to kill only cancer cells, while leaving normal cells unharmed. Many types of cancer cells are more susceptible to heat than healthy cells. In addition, injection of nanomagnets tethered to specific drugs give doctor's the potential to actively steer a drug to a specific part of the body.

Magnets have improved the quality of our lives, and will continue to find exciting new applications in the form of nanomagnets!