Putting a New Spin On the Science of Electronics

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It is often said that there is nothing new under the sun. However, looking more deeply into what is commonly understood can result in surprising new knowledge. Consider the electron, the negatively charged particle on the outer layer of the atom. The electron's charge is responsible for electricity and makes it possible to process data. The electron's spin underlies magnetism and makes it possible to store data. The entire electronics industry has been built on the known utility of this most basic particle.

The electronics industry is now undergoing rapid change, being pushed by a worldwide consumer desire for smaller and more efficient appliances that have increased data processing and storage capability. To meet this demand, engineers are working to lay the stepping stones to new technological breakthroughs in computer, audio, and video storage as well as sensor technology by using the spin as well as the charge of the electron, and by discovering how to transport electrical charge and magnetic spin through single atoms or nanoparticles. This science is leading to the development of magnetic thin films—single atomic layers of magnetic film, layered one upon the other and tested for their response to frequency, electrical resistivity, and their agility in signal processing.

This science could mean a new era defined by increased data processing speed, decreased power consumption and more affordable technology. Imagine an MP3 player that could store hundreds of thousands of songs; a laptop computer that could run on a single battery for weeks; or a cell phone that could store and protect data from degradation for decades. It's all possible, once breakthroughs are made in understanding how to best manipulate the electron's spin via electric and magnetic fields.

William Bailey studies the deposition and properties of magnetic ultrathin films. His research interests include nanoscale magnetic films and heterostructures, materials issues in spin polarized transport, and materials engineering of magnetic dynamics. He investigates novel magnetic properties for application in the emerging field of spintronics, and is particularly interested in designing magnetic materials with reduced energy loss for application in computing.

Prior to joining Columbia Engineering, Bailey held a National Research Council Postdoctoral Fellowship at the National Institute of Standards and Technology (NIST) in Boulder, Colorado. Honors for his research include the National Science Foundation CAREER and Army Research Office Young Investigator awards.

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