Critical Advances Made in Nanomagnetics for New Technologies

Supporting/Contributing Agencies: NIST

NIST's comprehensive, interdisciplinary program in nanomagnetics has made critical advances in the measurement, design, and application of magnetic nanostructures, paving the way for novel digital data storage technologies, future electronics, and advances in healthcare. These accomplishments are allowing industry to pursue new paradigms for electronics, particularly in devices that store digital information. For example, NIST has made pioneering advances in spintronics, a path to future electronics that uses the magnetic spin of the electron. The principles established in this research are now being used by industry to develop "ST-MRAM" — memory chips that retain their memory even when turned off. Additionally, NIST has developed an array of measurement techniques needed for the practical development of a wide range of nanomagnetic devices. These techniques use electrical, optical, microwave, and neutron scattering probes to elucidate the key properties that determine the performance of magnetic devices, ranging from sensors that read information in hard drives to cancer-fighting magnetic nanoparticles. Finally, magnetic modeling software developed at NIST has become the leading modeling tool for the design and optimization of nanomagnetic devices, allowing industrial researchers to solve complicated design problems hindering the development of new technologies. This object-oriented micromagnetic modeling framework (OOMMF) is also widely used in universities to train the next generation of nanotechnology scientists and engineers.

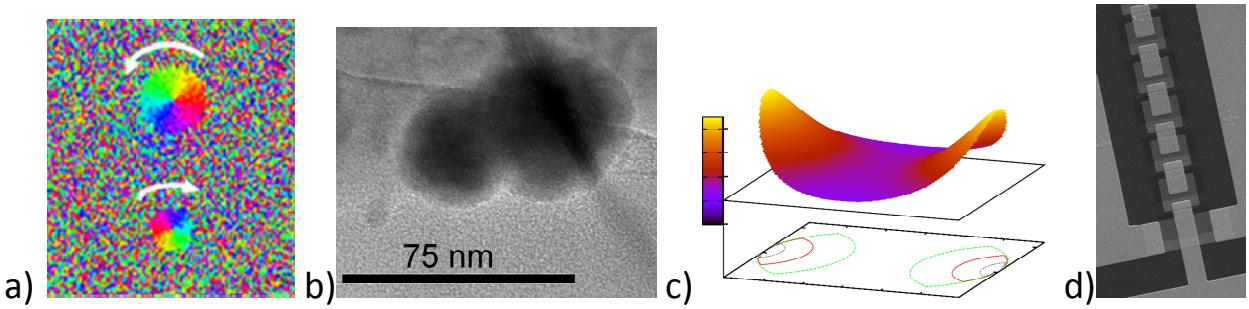

Figure 1. a) Magnetic domain images in 500 nm and 250 nm disks. b) Magnetic particles used in a tumor-heating study. c) OOMMF model of a 5 GHz magnetic vibration in a 100-nm diameter nanodisk.d) A chip used to measure interactions between spintronic nanocontact devices.

References/Publications/Patents

NIST has over 170 publications in nanomagnetics from 2005 to present. These papers have been cited approximately 1200 times, demonstrating the broad international impact of these accomplishments.