

Project Summary

A five year program by PI Axel Enders, titled "CAREER: Self-Assembled Magnetic Nanostructures", will cover the period from 1/1/2008 to 12/31/2012. The grant will support two months of summer salary per year for the PI, as well as one full-time graduate student and one part-time graduate student for five years. The students will perform low-temperature scanning tunneling microscopy/spectroscopy on self-assembled magnetic nanostructures as a part of their doctoral thesis, and X-ray magnetic dichroism experiments complementary to the local characterization on-campus. Funds are requested to purchase materials and supplies for the operation of the low-temperature scanning tunneling microscope throughout the five-year period, and for traveling to Synchrotron facilities for magnetic circular dichroism measurements.

Intellectual Merit

The magnetic anisotropy energy (MAE) is among the most important functional properties of magnetic elements. It determines the orientation and stability of the magnetization as well as the mechanisms and the dynamics of the magnetization reversal. A key result of this work will be an improved atomic-scale understanding of the MAE, which can greatly facilitate the engineering of nanostructures with MAE values that exceed those of currently-available materials by over an order of magnitude. This will permit the development of extremely high density magnetic recording media. The PI will implement his long-standing expertise in methods of synthesizing nanostructures with a precision and structural complexity well beyond the state-of-the-art; from isolated structures, to 2- and 3-dimensional hybrid assemblies. Our fundamental understanding of the MAE will improve significantly from the systematic study of (a) local coordination effects, (b) electronic hybridization with the supporting substrate and (c) interactions with molecular ligands in network structures. Conditions to achieve extremely large MAE will be identified, which could be useful for engineering the MAE by structural design. The work will also demonstrate self-assembled patterned media based on magnetic nanoclusters, which – if applied in magnetic recording – would allow for unprecedented bit densities beyond 80 Terabit per square inch. Exploring the limit of magnetic storage density at room temperature will be a key objective of this five year program

Broader Impact

The LT-STM lab built by the PI at his university will allow for training of undergraduate and graduate students with state-of-the-art tools in nanoscience. This will build the human infrastructure needed to continue research and development in a rapidly growing field that is seen as one of the most significant areas of research worldwide. The long-term goal is to create at UNL, a center of expertise in the important field of STM methods. The interdisciplinary nature of some aspects in this research program will foster research collaborations with other departments and is particularly conducive to a research climate that is attractive for undergraduate and graduate students.

The educational component of this proposal targets the long-term retention of women in UNL's undergraduate and graduate program in Physics. It is based on the PI's previous experience in efforts to improve avenues of success for women in research environments. The PI will coordinate activities to facilitate networking for women students at the national level, to disseminate their contribution in physics. As a key element of this program the PI will develop and host at UNL, a conference for undergraduate women in physics. A new partnership with leaders at UNL in educational outreach has already brought about funding for the first (pilot) year. It is expected that the proposed program will help attract and retain outstanding women physicists to the department and increase the percentage of women in the undergraduate and graduate program significantly.