Nanomagnetic Size Effects in Non-magnetic Materials

Ilan Goldfarb, **Matan Dascalu, Federico Cesura, Yossef Meir**

Department of Materials Science and Engineering, Faculty of Engineering
Tel Aviv University Email: ilang@eng.tau.ac.il, Web: http://www.eng.tau.ac.il/~ilang

Abstract

In this work, I shall survey our work on magnetic properties of epitaxial binary silicide nanostructures. While silicides possess set of properties useful for VLSI technology, they are not normally associated with magnetism and magnetic applications. Binary transition-metal silicides usually lack ferromagnetic order in the bulk-size crystals. Silicides of rare-earth metals, are weak ferromagnets or antiferromagnets at RT. Yet both groups tend to exhibit increased magnetic ordering in low-dimensional nanostructures, in particular at low temperatures. The origin of this surprising phenomenon is speculated to originate at undercoordinated atoms at the nanostructure boundaries, which may have 2D (surfaces/interfaces), 1D (edges) and 0D (corners) character, with our results pointing mostly to the nanostructure perimeters. Uncompensated spins of the nanostructure edge atoms align into a superspin, such that geometric shape anisotropy of the nanostructures in the array affects the resulting magnetic anisotropy stronger than the magnetocrystalline term, stabilizing ferromagnetic order against thermal excitation. Thus, in principle, magnetic response of nanostructure arrays can be controlled by manipulating size and shape of the nanostructures, providing a plausible route towards design of Si-based bit patterned magnetic recording media and spin injectors.

Short Biography

Ilan Goldfarb is a Full Professor and Head of the Department of Materials Science and Engineering at Tel Aviv University. After obtaining his doctorate in growth and transmission electron microscopy of thin multilayered films with Prof. Danny Shechtman at Technion's Department of Materials Engineering in 1994, he was granted a British Council Post-Doctoral Award joined the Department of Materials at Oxford University (UK), where he spent five years as a Research Fellow specializing in surface science, epitaxial growth, and scanning tunneling microscopy. He joined Tel Aviv University in 1999, and spent his 2010-2011 sabbatical year at the Nanoelectronics Research Group at Hewlett-Packard Laboratories in Palo Alto (Ca, USA) exploring electronic structure and conduction mechanisms in amorphous materials. Until recently, he has headed the TAU Wolfson Applied Materials Research Centre, and served on the Editorial Board of Applied Physics A. Prof. Goldfarb's current research focuses on self-organization of magnetic epitaxial nanostructures by scanning tunneling microscopy, electron diffraction and photoemission methods, and on electronic structure of amorphous oxide films.