Magnetic cuboidal particles as field sensors for microscaled magnetic stray field landscapes

J. Bugase,[1,2] C. Janzen,[1] A. Vereijken,[1] Y. Shubbak,[1] N. Weidt,[1] R. Huhnstock,[1] and A. Ehresmann[1]

[1]*Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel*
[2]*School of Physical Sciences, C. K. Tedam University of Technology and Applied Sciences, Ghana*

Recently, magnetic domain patterns engineered in thin-film systems have been widely used in data storage, spintronics, and magnetic imaging. Characterizing the micronscale magnetic stray fields emerging from these patterns remains a topical but challenging task[1]. We present a non-mechanical, optically trackable method to visualize effective magnetic field directions using anisotropically shaped magnetic particles. These particles are fabricated via 2-photon polymerization lithography and magnetic exchange-biased layer deposition to impinge remnant magnetization and achieve custom shapes and anisotropies. When positioned in the field landscape of a periodically patterned substrate [2] within a quiescent liquid, the particles spontaneously orient and reorient in response to local micron-scale stray fields. This enables efficient characterization of complex micro magnetic structures. We further explore probing local field variations with superimposed external fields, facilitating diagnostic and biomedical microfluidic applications [3].

References:

[1] N. Nistico et. al. Inorganics, 8(1), (2020), 6
[2] D. Holzinger et. al. J. Applied Phys, 11, (2013), 013908
[3] A. Ehresmann, et. al., Sensors 2015, 15, 28854-28888