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Editorial

Editorial: The September 2023 cover paper

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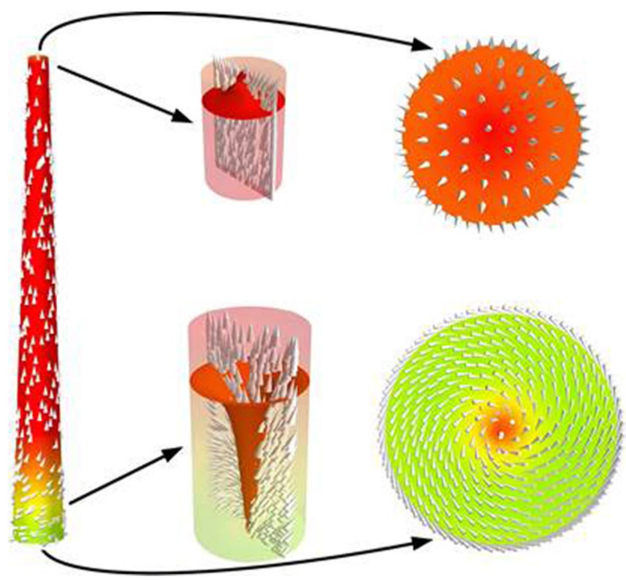
GRAPHICAL ABSTRACT



The cover for the September 2023 issues of the Journal of Materials Science comes from a paper by Kotti, Sahu, and Mishra, which appeared in volume 58, issue 27, published in July 2023 [1]. The paper is entitled "Magnetization reversal and coercivity mechanism in truncated conical nanowires of permalloy" and is part of our "Computation and theory" topical collection. One of the benefits to publishing in the Journal of Materials Science is that we do not have a page limit, which allows our authors to publish detailed and comprehensive articles. These authors took full advantage of this, as the article, with its 18 figures and three appendices, runs a total of 24 pages. Graphical representations of some of the magnetization states calculated for these nanowires are reproduced in the cover image. To fully appreciate these structures, I recommend reading the full paper. Articles published in the Journal of Materials Science all have a SharedIt link so they can be shared and read widely, regardless of whether they are open access. These SharedIt links can be shared and posted on personal websites to allow wide access to published papers as soon as they appear

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Kotti et al. described micromagnetic calculations of the magnetization states of truncated conical nanowires of permalloy. Magnetism researchers who have long careers or long memories will appreciate how far we have come from some of the foundational work that treated rods or wires as prolate spheroids or chains of spheres in order to calculate the shape anisotropy that arose from the high aspect ratio of the structure [2]. While that approach was practical for hand calculations and gave us methods for understanding relatively simple shapes, it could not provide the sort of insight of this current paper. Modern simulations have allowed us to understand the magnetization processes at the nanoscale so we now see that while saturation behavior can be understood using simple analogies between rods and strings of spheres, the actual mechanisms and dynamics of magnetic of strings of spheres is clearly influenced by the particle structures [3]. In this current paper, we can see the complexity and nuances of the magnetization directions of various regions of nanowires during the magnetization process and the static structures that remain after removal of the applied magnetic field. The cover represents one of these remanent magnetization states and shows the dominant vortex structure of the magnetization as well as the variation of the vortex core diameter as we move vertically through the nanowire. We also see the structure of the top and bottom planes of the nanowire in the remanent state. This is of course just one structure of a specific shaped permalloy wire. The paper describes other structures during the magnetization process and varies the dimensions of the wires, providing a detailed level of understanding that has only recently become possible.

While this work uses micromagnetic modeling, other recent work uses Monte Carlo simulation to understand the dynamics of magnetization of complex nanosystems [4]. These complementary approaches to modeling magnetization processes represent important basic science, but also have implications for technological developments. Magnetic information storage [5] is an obvious application that comes to mind, but magnetic hyperthermia [6] and electromagnetic shielding [7] are other technologies where detailed understanding of the magnetization mechanism and dynamics is absolutely critical.

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