Functional magnetic nanostructures for electromagnetic and biomedical applications

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ABSTRACT

Magnetic nanoparticles are being developed for applications ranging from high density recording, spintronic devices to nanomedicine. Surface functionalization and shape anisotropy of nanoparticles are key factors that govern the magnetic response. Dispersion of ferrite nanoparticles into a polymer matrix creates a new class of low-cost, lightweight nanocomposite materials with enhanced and tunable microwave properties for use in high-performance RF and microwave devices, such as integrated high-Q inductors and filters. A challenging issue in polymer nanocomposites is particle agglomeration into non-uniform clusters during the processing stages of thick films. Our research over the years has led to overcoming this limitation through surface functionalization. We have also fabricated high-aspect ratio magnetic nanotubes with excellent tunable microwave properties. Functional magnetic nanoparticles are currently being explored for several nanomedicine applications including contrast enhancement in MRI and magnetic hyperthermia treatment of cancer. There is a need to improve the specific absorption rate (SAR) and heating efficiency of nanoparticles for hyperthermia and our recent work has focused on the role of surface and interfacial anisotropy with a goal to enhance SAR. Strategies that go beyond simple spherical structures such as core-shell nanoparticle, exchange-coupled nanoparticles, nanowire, nanotube geometries can be exploited to increase saturation magnetization, effective anisotropy and heating efficiency in magnetic hyperthermia treatment of cancer cells. Overall I will discuss the role of advanced functional magnetic nanostructures in emerging electromagnetic and biomedical applications.
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Biographical sketch:

Hari Srikanth is a Professor of Physics at the University of South Florida in Tampa, FL. He received his Ph.D. in experimental condensed matter physics from the Indian Institute of Science (Bangalore) in 1994. After postdoctoral research for several years, Hari joined the University of South Florida in 2000 as an Assistant Professor and established the Functional Materials Laboratory. He became a Full Professor in 2009. Hari's research spans a wide range of topics in the area of magnetism and magnetic materials. Current research focus in his group include investigating magnetization dynamics in nanostructures, exchange bias, magnetic refrigerant materials, giant magneto-impedance (GMI), microwave materials, complex oxides with competing magnetic phases, spin caloric effects and applications of magnetic nanoparticles in nanomedicine. He has given over 130 invited talks and pedagogical tutorials around the world. Hari is a Fellow of the American Physical Society, Fellow of Institute of Nanotechnology, Marie Curie Fellow, International Association of Advanced Materials (IAAM) Medal recipient in 2016 and a senior member of IEEE. He is currently an Associate Editor for *Journal of Applied Physics*. Hari has been associated with the Magnetism and Magnetic Materials (MMM) conferences for several years as a program and steering committee member, publication editor and publication chair. He is one of the publication chairs for the 2018 International Conference on Magnetism (ICM) to be held in San Francisco. His research program over the years has received funding from the US Department of Energy, Army Research Office, National Science Foundation, Bizkaia Talent Program (Basque Country, Spain). Hari has held several short term visiting professor positions in Europe at Slovak Academy of Sciences (Kosice), Basque Center for Materials (Bilbao) and in Asia at Indian Institute of Science (Bangalore) and Indian Institute of Technology (Bombay).