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Magnetic properties of artificially frustarted Fe nanoparticle systems

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Frustration is evident in materials of common usage such as polymers, cholesteric liquid crystal systems, glassy and amorphous materials, due to their ability to co-exist in periodic and defected forms, as a scientific principle it has remained a strict theoretical concept, bound by equations of physics. We have been able to provide a form to frustration and the association of magnetic dynamics with frustration. We have prepared our superparamagnetic Fe nanoparticles, measuring about 7.5 nm across, by using a nonequilibrium process of electro-explosion of wires. Due to higher value of electron-phonon coupling for Fe, as electrons are unable to carry away sudden excess kinetic energy, disrupted lattice structure for the nanoparticles has been achieved. Thermoremanent magnetization experiments for Fe nanoparticles and their different nanocomposites with activated carbon performed by SQUID, provide spin relaxation dynamics and signify dissipation of stored magnetic energy by constituent assemblies. For the low temperature magnetic relaxation curves, exponential magnetic decay has been observed. This decay behaviour is ascribed to a dilute ensemble of superspins with random spatial distribution, anisotropy, and spin sizes. Due to positional atomic disorder established inside the Fe nanoparticle lattice, domains without boundaries are formed. This disorder is argued to generate large magnetic anisotropy regions, and demonstrated to be an important step for the oscillations to appear in the magnetic relaxation curves taken at higher tempertaures.

Biography

Satyendra Prakash Pal has completed his PhD at the age of 27 years from Jawaharlal Nehru University, New Delhi, India and currently is a postdoctoral research associate in Department of Physical Sciences, Indian Institute of Science Education and Research Mohali, India. His research interst includes study of static and dynamic magnetic properties of artificially frustrated nanoparticle systems. Currently he is working on spin injection and universal conductance fluctuation (UCF) in metals.

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