**Functional magnetic nanostructures for tunable RF and biomedical applications**

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Magnetic nanoparticles are considered fundamental building blocks for spintronic devices. Surface functionalization and shape anisotropy of nanoparticles are key factors that need to be precisely controlled. 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 experiments over the years have led to overcoming this limitation through surface functionalization. We have also fabricated high-aspect ratio magnetic nanotubes with excellent tunable microwave properties. For nanomedicine and biosensing applications, a combination of these functionalized hybrid nanoparticles with giant magnetoimpedance (GMI) based sensing elements offer a promising approach for highly sensitive detection of cancer cells and biomolecules. Strategies that go beyond simple spherical structures such as core-shell nanoparticle, nanowire, nanotube geometries can be exploited to increase saturation magnetization 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.