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Tuning physical properties at the nanoscale through controlled nanostructuring or proximity effects

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The overall goal of the group of Magnetic Nanomaterials at the University of Barcelona, Spain (https://magneticnanomaterialsub.wordpres is to tailor magnetic and optical properties at the nanoscale taking advantage of the degrees of freedom associated with the actual nanostructure of the systems. We specialize, on the one hand, on the study of the intimate correlation between the nanostructure and the physical properties (magnetic, electronic, plasmonic, transport properties) of a variety of nanostructures. On the other hand, on how these properties are affected by finite-size, surface, proximity, and interfacial effects, together with inter-particle interactions and quantum phenomena, among others.

Our current research lines include:

- Enhanced functionalities in nanoparticles and hybrid nanostructures.
- Proximity effects in hybrid nanostructures.
- Theoretical models and simulations of magnetic nanoparticles.
- Geometrically frustrated networks of plasmonic nanoelements. Functionality for Surface-enhanced Raman spectroscopy and sensing applications.
- Chiral plasmonic nanostructures.
- Development of phononic/thermal applications using ferroelectric oxides.
- Electric field control of magnetism using ferroelectric-ferroelastic-magnetic epitaxial heterostructures.

The activity of the group is devoted to cover the whole chain of value, from the development and optimization of new synthesis and/or nanofabrication routes of a wide variety of high-quality materials with relevant magnetic, electronic, electron transport and/or plasmonic properties, to the comparison of our experimental results to numerical simulations and theoretical pseudo-phenomenological models, together with the envisage of the potential application. Special emphasis is put on the use of an advanced set of complementary characterization techniques, many of them probing local properties, from scanning-probe to electron-microscopy and synchrotron-based. Potential applications include the use of magnetic nanoparticles in biomedicine, magnetic nanostructures in magnetic recording and plasmonic arrays in sensing, enhanced spectroscopies, and perfect absorbers.

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