Applications of Magnetic Nanostructures and Relevance of Mössbauer Spectrometry

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Nanotechnology which refers to the design of functional devices from manipulation and selfassembly of atoms, molecules or clusters, should be one of technologies most relevant and challenging in different industrial applications for the coming decades. Indeed, the use of nanomaterials does contribute to reduce ecological stress, energy consumption and natural resources. But the use of nanomaterials requires to evaluate carefully the risks to the workers during elaboration and manufacturing, to the environment and to the consumers for risks of exposure and toxicological aspects. Consequently, it is necessary to control the morphology and the chemical nature, the temperature and time stability and the physical properties of nanomaterials. Among the different techniques which can be used, ^{57}Fe Mössbauer spectrometry is relevant to probe surface and bulk structures, and to determine on the one hand the role of the surface or of the grain boundaries in the case of nanoparticles and nanostructured powders, respectively and on the other hand the hyperfine magnetic properties and their dynamics in correlation with superparamagnetic relaxation phenomena in the case of magnetic nanostructures.

The different types of nanostructures will be first established in conjunction with their potential applications allowing thus to discriminate the relevant parameters which influence the physical properties and their changes compared to bulk microstructures. We illustrate from selected examples how both the selectivity and the local probe character of ^{57}Fe Mössbauer spectrometry contributes to investigate *in situ* local atomic order and magnetic properties in different nanostructures, as nanocrystalline alloys, nanostructured powders, nanoparticles and assemblies of particles and functionalized nanostructures and mesoporous hybrides ((Metal Organic Frameworks, MOFs).