Magnetic Nanoparticles in Bioreactors for Theranostic Applications: Host-Guest Characterization by EPR and Mössbauer Spectroscopies

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Magnetic nanoparticles, MNPs, mineralized within a human ferritin protein cage, HFt, can represent an appealing platform to realize smart therapeutic agents for cancer treatment by drug delivery and magnetic fluid hyperthermia [1]. We have investigated MNPs of spinel type iron oxide (of approximately 8 and 4 nm) mineralized in the internal cavity of the bioreactor ferritin-like nanocage in order to deepen our knowledge on them, a fundamental prerequisite for their effective use. In particular, we have used Electron Magnetic Resonance (EMR) spectroscopy and taken advantage of the capacity of the protein shells to control the size of the MNPs. EMR measurements in perpendicular and parallel configurations have been recorded at various temperatures. An approach based on the giant spin is used to interpret the experimental results. The analysis indicates that the observed quantum behaviour has to be ascribed to the whole MNP and that the thermal population of excited spin states has a strong influence in the EMR behavior of MNPs.[2,3]

The host reactors (ferritin) contain 24 ferroxidase centers, where the mineralization initiates, each constituted by two metal binding sites. These have been characterized by a combination of Mössbauer and EPR experiments that have unveiled beyond iron also manganese binding and its involvement into the protein function.[4]

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