SUPERPARAMAGNETIC NANOPARTICLES WITH RELEVANT APPLICATIONS IN BIOMEDICINE: NMR STUDIES

Ana Taborda[1,2] *Alexandra Carvalho*[1,3]
[1] *Centro de Física da Matéria Condensada - UL, Av. Prof. Gama Pinto 2 1649-003, Lisboa*
[2] *Instituto Superior Técnico, Av. Rovisco Pais, 1049-001, Lisboa*
[3] *Escola Superior de Tecnologia da Saúde de Lisboa – IPL, Av. D. João II, Lote 4.69.01 1990 – 096, Lisboa*
Portugal
ataborda@cii.fc.ul.pt

Nuclear Magnetic Resonance (NMR) Spectroscopy is a powerful experimental technique to investigate several properties of a wide range of materials. NMR relaxometry in a broad Larmor frequency range allows molecular dynamics investigations of interesting systems, namely materials with potential biomedical applications.

Combining Conventional NMR and Fast Field Cycling (FFC) NMR it is possible to obtain longitudinal relaxation times (T_1) for a great number systems from very low frequencies (~ kHz) [1] to very high ones (~800 MHz).

The use of superparamagnetic nanoparticles in biomedicine is well known and has grown fast in the last years [2].
Superparamagnetic nanoparticles have found application as contrast agents for magnetic resonance imaging, because of their capacity to modify the tissue relaxation times [3].
The development of new contrast agents requires understanding of the physical processes behind the efficiency (relaxivity) of the contrast agent to change the tissue relaxation times. NMR studies provide access to the relaxivity of the contrast agent as well as the quantification of characteristic parameters of the superparamagnetic particles [4].

Proton longitudinal relaxation time dispersion curves on Larmor frequency (proton-NMRD) of aqueous superparamagnetic nanoparticles systems used in Magnetic Resonance Imaging will be presented. The aqueous colloidal suspension of superparamagnetic iron oxide particles studied was composed of 80nm to 150nm global size nanoparticles (Small Particle Iron Oxide – SPIO), dextran coated.

The dispersion of the longitudinal relaxation rate on Larmor frequency, $1/T_1(\nu)$, (proportional to the longitudinal relaxivity, r_1) is well described by the theoretical model developed by Alain Roch [5] for the SPIO. Some important parameters were estimated based on this model: the mean radius of the nanoparticles, their "huge" magnetic moment, the translational correlation time and the Néel relaxation time, which is a characteristic parameter of superparamagnetic nanoparticles hardly accessible by other experimental techniques.

References:

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