Probing internal fields and Ghz dynamics in thin film by nuclear resonant scattering

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In thin film technology, it remains difficult to obtain direct, local, microscopic information on materials. This is mainly due to the fact that conventional experimental techniques relies on the measure of a still macroscopic (or ensemble averaged) quantity, such as the total (net) magnetization in magnetic thin films. In this contribution, I will present some examples where the local probe technique of nuclear resonant scattering \cite{1} of synchrotron radiation is used to probe internal magnetic fields on thin film. As will be shown, the local moment behavior of the method allows analysis that cannot be simply obtained from conventional techniques. In addition, I will present preliminary results where the method is applied on the superparamagnetic/ferromagnetic transition appearing upon cooling Fe nano-islands below their blocking temperature. As will be shown, the sensitivity to Ghz dynamics of the methods allows to retrieve inormation such as flipping rate, average angular distribution of the local magnetic moments. This unique view on local spin dynamics can then also be applied on systems relevant for applications, in spintronics and spin-torque devices.

\cite{1} R. Röhlsberger, \textit{Nuclear Condensed Matter Physics with Synchrotron Radiation, Springer Tracts in Modern Physics}, Vol. 208 (Springer-verlag), Berlin, 2004