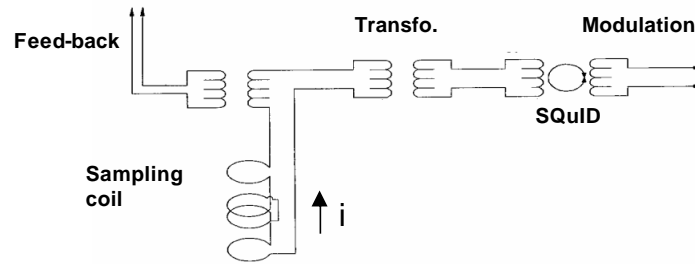


Magnetic measurements - MPMS Quantum Design

Figure 1 : basic scheme of MPMS Quantum Design



When a magnetic sample is displaced between a supraconducting coil, a current i is induced which flows without losses to a transformer; the secondary circuit generates a flux in a third coil which will be detected by a SQUID detector (Superconducting Quantum Interference Device). Such a detector consists in a supraconducting loop comprising two Josephson junctions, Figure 2, the critical current of which, I_c , can be measured.

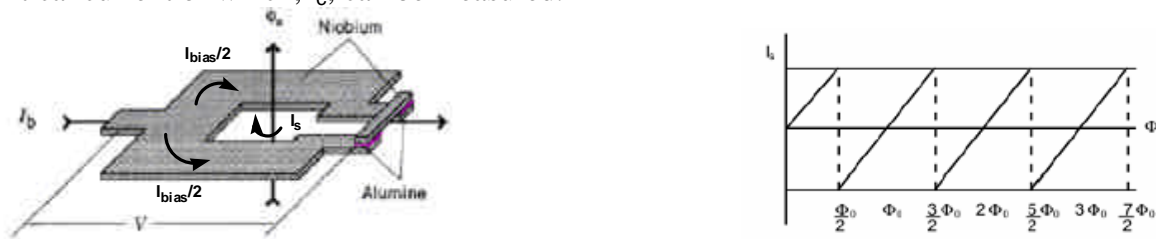


Figure 2 : left : basic scheme of a SQUID loop, the two Josephson junctions, e.g. 1 nm thick insulating alumina barrier, are drawn in pink; right : effect of an external magnetic field generating a magnetic flux Φ on the current intensity in the loop. ($\Phi_0 : h/2e = 2,07 \cdot 10^{-15}$ Wb)

As the magnetic flux in the loop of a supraconducting material is quantified, operating this device in bias conditions such as I_{bias} is slightly above I_c , leads to the conversion of the magnetic flux into an oscillating current, which will be used to modulate the electric signal in the last coil (right part, Figure 1). This last signal is used in a feed-back procedure to inject an electric current in the primary supraconducting circuit in order to suppress the current induced by the displacement of the magnetic sample. Such a procedure gives a measurement of high precision and is very sensitive.

Applications :

This detection mode is compatible with a large panel of experiments, such as the study of the variation of the magnetization of a compound as a function of its temperature (Figure 3, left), measurements of hysteresis circles (Figure 3, à droite)... on very small quantities (few mg). The critical measurement time in DC mode lies between 1 to 10s, i.e. static mode.

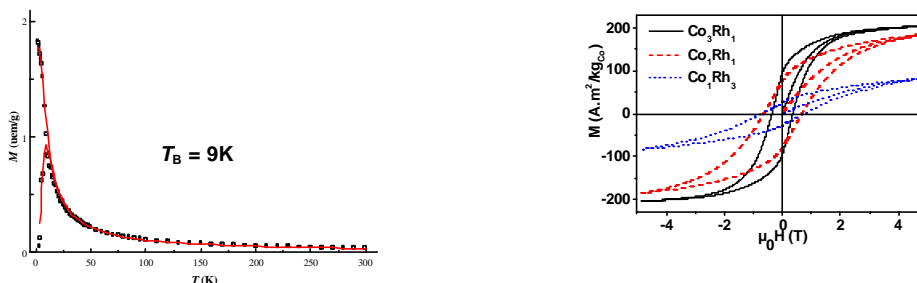


Figure 3 : left : ZFC/FC curve from cobalt nanoparticles, 1.6(+/-0.5)nm in diameter, dispersed in polyvinylpyrrolidone: the blocking temperature, anisotropy and size distribution of the nanoparticles can be determined via a fit of this curve. Right : hysteresis loops for CoRh nanoparticles showing the effect of an increase in the Rh ratio in the nanoparticles on the coercive field.

Selected publications : O. Margeat, et al. *Chem. Mater.* 2005, **17**, 107; D. Zitoun, et al., *J. Phys. Chem. B* 2003, 107, 6997 ; M. Respaud, et al., *Phys. Rev. B* 1998, **57**, 2925.