Report of SC-2330

The investigated composite-type material consisted of a polyurethane gel and carbonyl iron (CI) of 7 μm size spheres. The gel constituents were: MDI/OAE+DCDA with a molar ratio 80/20. The material was synthetized with 11.5vol.% of CI, under magnetic field of 300mT, during 24 h at 25°C. SEM images of the composite showed short chains of CI formed inside the material.

X ray Photon Correlation Spectroscopy (XPCS) measurements, I(q,t), were performed in SAXS geometry at the Troika beamline (ID10C) of the ESRF. The time (t) and angle (q) resolved measurements used apartially coherent X-ray beam with a wavelength of X-beam of 1.75 Å. The speckle pattern from the sample were recorded by a two-dimensional CCD detector. The samples, in form of thin (~ 40μm) slice of the composite material, were held in place between electromagnet poles with the magnetic field lines oriented perpendicular to the X-beam and parallel to the sample surface and the embedded CI chains, respectively. Measurements were performed for: 0, 300 and 600 mT. It occurred **that** typical relaxation times ranged from 5 x 10^2 to 100 x 10^2 sec. The speckle patterns were recorded with about 1sec acquisition time and 6 sec lag time between images.

The second order intensity correlation functions: $g_2(q,t)=\langle I\ (q,t_o+t)I(q,t_o)\rangle/\langle I(q,t_o)^2\rangle$ were calculated from the speckle pattern providing *I(t,q)*. By using software masks, the correlation functions were calculated for the scattering parallel (par), isotropical averaged (iso) and perpendicular (per) to the magnetic field lines.

The curves at 0 mT, i.e. reference curves, are of extremely slow dynamics with correlation times reaching about 10^4 sec and of marginal differences between the measurement directions. For 300 mT, the dynamics is faster (decay times ~ 1.2 x10^3 sec) and exhibits also a dependence on the different directions. For 600 mT the decay times become even the faster, less than 10^3 sec, while the correlation curve slopes are more complicated.. The relaxation rates, $\Gamma(q)$ were found by fitting exponential function: $y = a\ e^{-\Gamma x}$ to the subsequent $g_2\ (t)$ curves, in their region of correlation. Fig. 1 shows $\Gamma(q)$ curves for subsequent magnetic field value, with sets of 3 curves for each direction (par, iso and per). When the magnetic field increases, the relaxation rate also increases. It occurred that the magnetic field essentially influences the relaxation rate, up to 10 times for the highest used field (Fig 1). Besides, within each set the largest relaxation rate is observed for in the direction parallel to the magnetic field (par), the lowest one in the direction perpendicular to the magnetic lines (per) and an intermediate one for isotropic (without mask) average. A linear functional form is observed for all $\Gamma(q)$ curves.

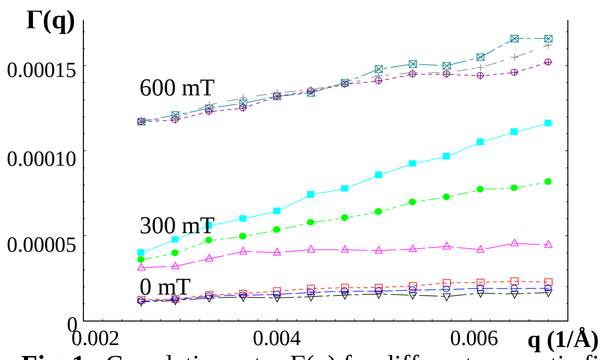

Fig. 1. Correlation rates Γ(q) for different magnetic field values. At each 3 curves set: bottom – per, middle- iso, top – par.

Table. I. Diffusion coefficients [Å/sec]

	0 mT	300mT	600mT
par	0.0027	0.0180	0.0119
iso	0.0018	0.0109	0.0096
per	0.0011	0.0029	0.0083

In the case of linear $\Gamma(q)$ shape, the relation between the relaxation rate and the diffusion coefficient, *D[Å/sec]*, is given by: $\Gamma = D\ x\ q$. The D values were found from the slope of straight lines fitted to $\Gamma(q)$ (Table I).

For the reference curves for 0 mT the very moderate values of the *Γ(q)*,and *D* as well as no differentiation from direction seem to be an evidence of very strong structure. For the intermediate value of the magnetic field (300 mT), the same parameters are strongly dependent on the magnetic field direction and are of much bigger values (Fig. 1 and Table I). Here the dependence of the material dynamics on the direction of the outer magnetic field is very clear, with parallel direction (par) being very privileged i.e. exhibiting the largest *D*. Contrary, at 600 mT, the dependence on the magnetic field direction becomes weak and the *D* are smaller compared to the scenario at 300mT (Fig1 and Table I). Simultaneously, the relaxation rates *Γ(q)* exhibit larger fluctuation around the fitted straight lines. There mechanism of the dynamics behavior may be altered in this case