ESRF	**Experiment title:** SAXC and XPCS study of urethane magnetorheological elastomers mesostructure under magnetic field	**Experiment number**: SC-2330
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Report:

Composite-type material consisted of polyurethane gel, and carbonyl iron (CI) of 7 μm size spheres. The gel constituents were: MDI/OAE+DCDA with molar ratio70/30. The material was processed with 11.5vol.% of CI under magnetic field, during 24 h at 25°C.

SEM images of the composite showed short chains of CI formed inside the material.

XPCS measurements, I(q,t), were performed in SAXS configuration on the Troika beamline ID10C of the ESRF synchrotron, using X-beam of wavelength 1.74872 Å, and detector type CCD. The sample was placed between the electromagnet poles, with magnetic lines direction perpendicular to the X-beam and parallel to the sample surface and CI chains. Measurements were performed for: 0, 300 and 600 mT. It occurred that correlation of scattered intensity took place in the time range: from 5×10^2 to 100×10^2 sec, with about 7sec acquisition time of a single measurement

Correlation curves, $g_2(t)$, according to the formula: $g_2(t)=\langle I(t_o +t)I(t_o)\rangle / \langle I(t_o)^2 \rangle$

were obtained from the measurements using masks, to get them in directions: parallel (par), isotropic (iso) and perpendicular (per) to the magnetic field lines.

The curves at 0 mT, i.e. reference curves, are of extremely slow dynamics behavior with correlation reached for about 10^4 sec and of weak differentiation between the measurement directions. For 300 mT, the correlation is faster (~ 1.2×10^3 sec) and there is a distinct dependence on different directions. For 600 mT the correlation is the fastest, of less than 10^3 sec, but $g_2(t)$ slopes are more complicated.

Correlation rates, Γ (q). The $\Gamma(q)$ were found by fitting exponential function: $y = a\, e^{-\Gamma\, x}$ to the subsequent $g_2(t)$ curves, in their region of correlation.

$\Gamma(q)$ curves for subsequent magnetic field value, form sets of 3 curves for each direction (par, iso and per).

When magnetic field increases, from 0 through 300 to 600 mT, correlation rate also increases. It occurred that the magnetic field essentially influences the correlation rate, up to 10 times maximally Besides, within each set the highest curve is for direction parallel to the magnetic field (par), the lowest one for direction perpendicular to the magnetic lines (per) and the middle

one is for isotropic (without mask) measurement. The straight-line shape of all $\Gamma(q)$ curves are visible with no significant deviations from it. The correlation process is thus not due to structural reorganization on measured length scale.

In the case of linear $\Gamma(q)$ shape, the its dependence on diffusion coefficient is: $\Gamma = D \times q$. The D values were found from slopes of straight lines fitted to $\Gamma(q)$.

 For the reference curves for 0 mT very moderate values of the $\Gamma(q)$, and D as well as no differentiation from direction seem to be an evidence of very strong structure.

 For the middle value of the field (300 mT), the same parameters are of much bigger values and are strongly dependent on the magnetic field direction with parallel direction (par) very privileged.

 But for magnetic field of 600 mT, despite the highest correlation rate, the Γ dependence on magnetic field direction, as well as D values, became weak. Simultaneously, on the $\Gamma(q)$ curves the bigger fluctuation around the straight lines are observed. It can be caused by a change of dynamics mechanism.