# Dynamical Study on Nanocomposite Hydrogel by Means of Neutron Spin Echo Technique

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"Nanocomposite" is a current key aspect for development of advanced materials [1], e.g., polymer-clay nanocomposite in synthetic systems [2]. Recently, polymer-clay nanocomposite hydrogels (NC gel) have been developed by Haraguch et al. [3, 4], which have extraordinary superior properties as large deformability with high elasticity, quick shrinkage after large deformation, non-destructivity, high optical transsparency, and so on. Since conventional organogels are very fragile, these characteristics of NC gels are great advantages for material use.

We have studied the static structure of NC gel in detail by means of contrast variation SANS [5], and confirmed that the polymer chains are adsorbed on clay surface, then the clay nanoparticles work as 2-dimensional cross-linkers.

In this study, dynamical property of the nanocomposite hydrogel was investigated by means of neutron spin echo technique. Since 10.8 Åwavelength neutron beam was unsed for low $Q$ region ($0.04 \leq Q[\text{Å}^{-1}] \leq 0.07$), the achieved maximum Fourier time was a bit more than 40ns, while 7.3 Åwavelength neutron beam was unsed for high $Q$ region ($0.09 \leq Q[\text{Å}^{-1}] \leq 0.2$), so that the maximum Fourier time was 15ns in that case. Fig. 1 shows the measured normarized intermediate scattering functions from the nanocomposite gel consisting of 4 vol% of polymer and 1 vol% of clay with deuterated water. The curves in Fig. 1 show the fitting results with

$$\frac{I(Q,t)}{I(Q,0)} = \exp(-\Gamma t) \qquad (1)$$

at short Fourier times ($<$ 5ns). It is clearly shown that the measured intermediate scattering functions decay as like as liquids, but do not decay exponentially at longer Fourier time, which may be due to the gel structure, i.e., the polyer gels are macroscopically solids but microscopically liquids, and the polymers can flow in short time scale but their center of masses are frozen for longer time scale.

## References

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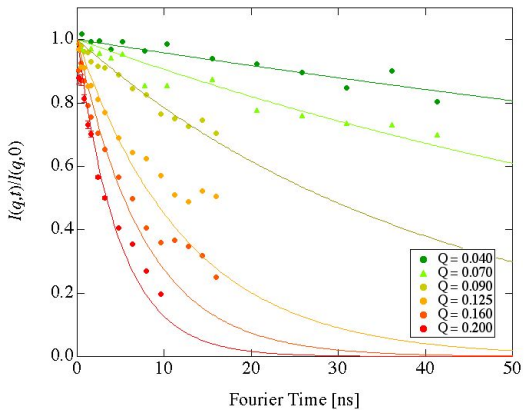


Fig. 1. Normalized intermediate scattering functions I(Q,t)/I(Q,0) obtained from the nanocomposite hydrogel.