Measurements of slow dynamics of actin

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F-actin, a helical polymer formed by polymerization of the monomers (G-actin), plays crucial roles in various aspects of cell motility. Flexibility of F-actin has been suggested to be important for such a variety of functions. Understanding the flexibility of F-actin requires characterization of a hierarchy of dynamical properties, from internal dynamics of the actin monomers through domain motions within the monomers and relative motions between the monomers within F-actin to large-scale motions of F-actin as a whole. As one of the ongoing projects towards this ultimate goal, we have been studying the dynamics of actin in a pico- to nanosecond time range by neutron spin-echo (NSE) spectroscopy.

As a continuation to the experiments done in 2006, we carried out two kinds of the NSE measurements: one was the measurements with a wider Q-range in order to obtain the detailed Q-dependency of the relaxation times, from which information on the collective motions such as the actin protomers in F-actin and the domain motions in the actin protomer were obtained; the other was the measurements on longer time scales, in order to make more accurate estimation of the relaxation times possible.

G-actin and F-actin were purified from rabbit skeletal muscles, and suspended in D2O. The NSE measurements on these solutions were carried out on the spectrometer iNSE, run by the University of Tokyo, installed at the guide hall of the research reactor, JRR-3M, Ibaraki, Japan. Two experimental set-ups enabled us to measure the intermediate scattering functions in the Q-range between 0.04 Aˆ-1 and 0.2 Aˆ-1 at the Fourier time up to 15 nsec, and those in the Q-range between 0.03 Aˆ-1 and 0.12 Aˆ-1 at the Fourier time at least up to 30 nsec. Figure 1 shows the combined results of these two measurements. It is shown that although the relaxation times of the intermediate scattering functions of F-actin is very slow compared to those of G-actin, each intermediate function can be fit with a single exponential, from which effective diffusion coefficients can be estimated. Behavior of the effective diffusion coefficients of G-actin as a function of Qˆ2 corresponds to free diffusion in solution whereas that of F-actin seems to reflect the collective motions within F-actin. Detailed analysis is currently underway.

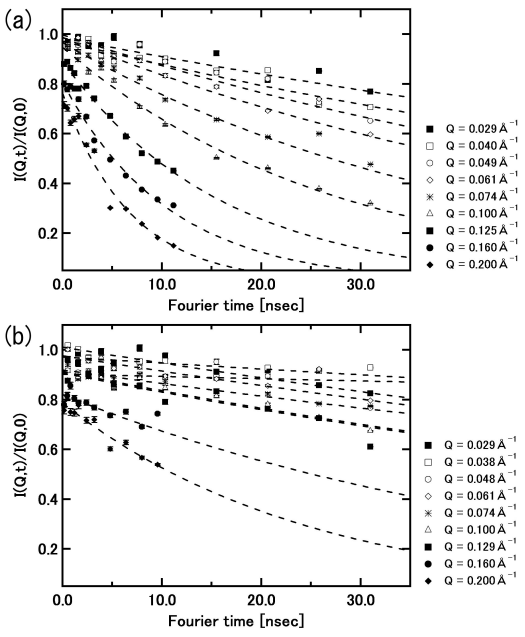

Fig. 1. The normalized intermediate scattering functions of (a) G-actin and (b) F-actin