Transient measurement for photo-induced changes in J-PARC - time-resolved neutron reflectivity measurement for silver photo-diffusion into Ge-chalcogenide films-

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Study on photo-induced changes for specific light-sensitive materials is fascinating from both academic and application points of view because it is one of the frontiers in materials science including concepts of electron-excitation and non-equilibrium state, and the materials can be controlled spatially by illuminated area from distant place. Time-of-flight neutron reflectometry, in which both incident and reflected angles are fixed, is suitable technique for probing time-evolutionary changes in thin films, especially for X-ray sensitive materials. The flux of neutron beam limits the time resolution in the measurement and present proton beam power of 300kW in J-PARC can assure observations of time-evolutionary changes in the minute time-domain, or possibly, in much shorter one.

Here we report recent results of time-resolved neutron reflectivity measurements for silver photo-diffusion into Ge_xS_{1-x} (x=0.20, 0.33, 0.40) films performed on BL17 (*SHARAKU*) [1]. It is well known that silver diffuses into Ge-chalcogenide layer by visible light exposure with a distinct diffusion front, where the silver concentration abruptly drops off. Using an event recording system at the Materials and Life Science Experimental Facility, neutron reflectivity profiles were collected with a time-resolution of 30 seconds in the shortest case. It was found from the measurements that a relatively stable Ag-rich phase in the reaction layer is firstly formed, and then, slower diffusion occurs at the interface between Ag-rich and Ag-poor layers. Fourier transform analysis showed that the position of the interface is essentially fixed. This result is in contrast to the previously reported model of silver diffusion that postulates a mechanism involving progression of the diffusion front. The results of the measurements on Ag/Ge-Se films performed on the INTER instrument at ISIS are also reported.

[1] Y. Sakaguchi *et al.*, accepted to Can. J. Phys.; the measurements for x=0.2 and 0.4.