Development of sample environments of SOFIA reflectometer for seconds-order time slicing measurement

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Neutron reflectometry is one of the most powerful tools for investigating the surface and interfacial structures in the spatial range of nano meters to sub-microns. The SOFIA is a horizontal-type neutron reflectometer at BL16, J-PARC/MLF. This reflectometer can utilize very wide wavelength band from 0.2 nm to 1.76 nm at a time to measure wide-Q data without any angle scan. This is the big advantage for time-slicing measurement because a time for changing the angles is not needed. So far, the SOFIA realized the time-slicing measurement with the time slice of a few minutes thanks to the high flux neutron beam of J-PARC/MLF.

In this study, we developed sample environments of the SOFIA to promote the time-slicing measurement for investigating kinetic processes on structural changes. A sample cell for observing the structural change on contact with liquid equips a solenoid valve and the liquid in the reservoir falls down when the valve opens. Then, the liquid contact with a substrate at the bottom within 10 seconds and the structural change due to the liquid can be observed by counting reflected neutrons at the sample surface through the substrate. In addition, we purchased a heating system with 100W infrared laser for a 2 inch substrate. This laser heating system can heat up the substrate from room temperature to 200°C within only 10 seconds.

Now, the time bin of the data is typically a few minutes. This is expected to be ten times quicker after the upgrade of not only the J-PARC accelerator but also the detector of the SOFIA near future.