Optimization of Radial Collimators for a Powder Diffractometer SPICA

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SPICA, a special environment neutron powder diffractometer for studying battery materials, has been installed at BL09 of J-PARC/MLF in 2012. Coarse radial collimators are placed in front of the ^{3}He neutron detector to reduce background. In order to remove unwanted scattering from battery apparatus and to narrow the evaluation region of the sample, the fine radial collimators are planned to be placed between the sample chamber and the coarse collimators. We designed the fine radial collimators to meet the requirements.

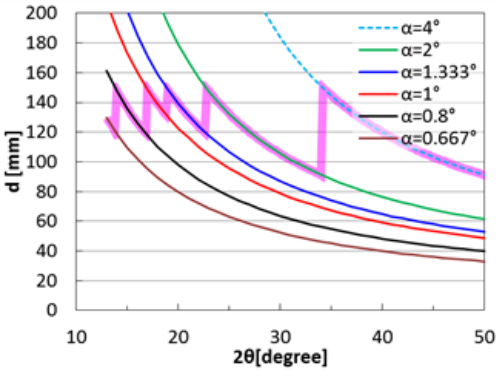

Fig. 1: 2θ dependence of d under each α that matches coarse radial collimators. Thick line shows the optimal α of each 2θ so that d < 150 mm is satisfied.

The structure of the fine radial collimator is designed so that scattered neutron from substance which has the larger distance from the center than d can be completely shielded by the radial collimators [1]. We have derived d by taking into account the effect of coarse radial collimator.

The blade-to-blade angle α of the fine radial collimator can takes only 4°/n (n is a natural number) to be consistent with the opening angle (4°) of the coarse radial collimators. So the fine radial collimator blades can be designed optimally by changing α stepwise so as to be wider at around 2θ=90°. As an example, the case where d < 150mm is required is shown in Fig. 1. On the other hand, in case the evaluation region of the sample needs to be narrowed, the angle α has to be set fine, even at around 2θ = 90°.

The design concept is generalized to the radial collimators located at the elevation angle.

References

[1] A. F. Wright, Nuclear Instruments and Methods **180**, 655-658 (1981).