High-Energy X-ray Diffraction Experiment on GeO_2 Glass

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High-energy synchrotron X-ray diffraction is considered a new probe in non-crystalline materials (liquids and glasses) research because it combines the high penetration power of thermal neutrons with the enlarged range of Q ($Q = 4\pi\sin\theta / \lambda$) leading to a better direct space resolution [1]. Direct comparison between the wide-Q range X-ray and neutron diffraction data using same sample and the same environment is possible.

The diffraction experiment was carried out on the two-axis diffractometer tentatively built at high-energy BL08W wiggler beam line at SPring-8. The set-ups of slits and detectors with the diffractometer covered the range of Q=1.5 - 40.0 $Å^{-1}$ at an incident photon energy of 274 keV.

The resulting X-ray weighted structure factor S(Q) for GeO_2 is shown in Fig. 1, compared to the earlier diffraction studies using 11 keV (conventional) X-rays and pulsed (white) neutron radiation. The figure is illustrating that the high-Q data of the present study has seriously poor statistics though the Q-range is equal to that of pulsed neutron study. Such a experiment will be completely allowed by the use of high-flux 50 - 150 keV X-rays and focusing.

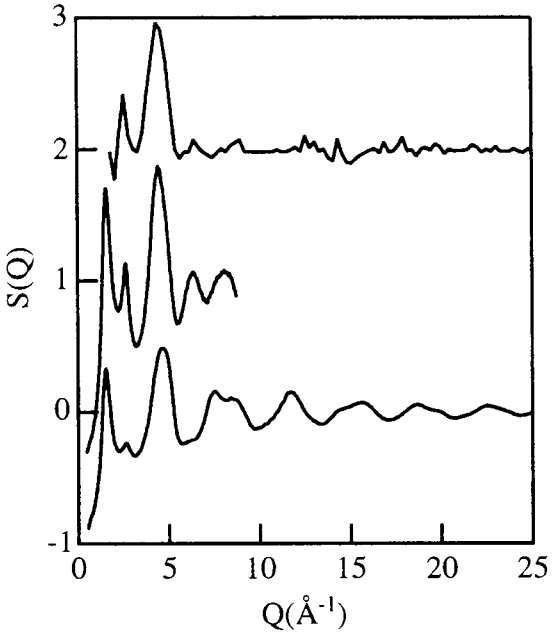

Fig. 1. Comparison of the structure factor of GeO_2 glass obtained with 274 keV photons (upper, this work), 11 keV photons (middle), and thermal neutrons (lower).

Reference

[1] H.F. Poulsen, J. Neuefeind, H.-B. Neumann, J.R. Schneider and M.D. Zeidler, J. Non-Cryst. Solids 188 (1995) 63