Experimental report

15/09/2016

Proposal: TEST-2596 **Council:** 4/2016

Title: Structure of SiO2 recovered from high pressure

Research area:

This proposal is a new proposal

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Samples: SiO2

Instrument	Requested days	Allocated days	From	To
D4	2	2	22/06/2016	24/06/2016

Abstract:

Test Experiment TEST-2596

The aim of this work was to establish the mounting setup on D4c for measuring accurate diffraction patterns for small samples of permanently densified glass. For this purpose, samples of permanently densified SiO_2 glass were provided by S Kohara (Center for Materials Research by Information Integration, NIMS, Tsukuba, Japan), along with a sample of "normal" glass having the same dimensions (Fig. 1). The latter refers to a standard piece of SiO_2 glass as prepared at ambient pressure.

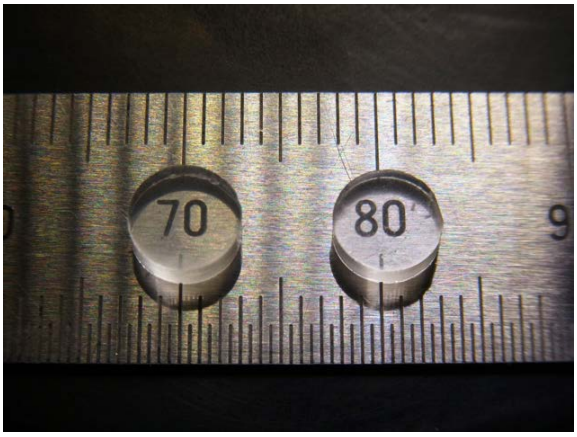

Fig. 1. Samples of "normal" SiO_2 glass (left) and 23% densified SiO_2 glass (right) with an approximate diameter of 5.7 mm and thickness of 1.5 mm.

Two setups were tested, namely (i) resting the sample on a thin-walled vanadium tube to minimise background scattering, and (ii) holding the sample within a thin-walled vanadium can. The first setup was mechanically unstable and could not be pursued. The second setup avoided this issue, but at the expense of increased background scattering from the vanadium can.

In view of (i) the small sample size and (ii) the small scattering and absorption cross-sections of Si and O, attenuation and multiple scattering corrections were not made. The data sets were normalised using the calculated self-scattering cross section, and inelasticity corrections were made by using the method described by Yarnell et al. (Phys. Rev. A **7** (1973) 2130). The resultant $S(q)$ functions are shown in Fig. 2 where

$$S(q) = \frac{\sum_\alpha \sum_\beta c_\alpha c_\beta b_\alpha b_\beta [S_{\alpha\beta}(q) - 1]}{\langle b \rangle^2},$$

c_α and b_α are the atomic fraction and bound coherent neutron scattering length of chemical species α, $\langle b \rangle = \sum_\alpha c_\alpha b_\alpha$ is the average scattering length, and $S_{\alpha\beta}(q)$ is a partial structure factor.

A separate experiment was performed using a solid cylindrical rod of "normal" SiO_2 glass in a regular setup with a beam height of 4 mm, and a full data analysis procedure was employed (Salmon et al. Phys. Rev. B **58** (1998) 6115). As shown in Fig. 2, the measured total structure factors $S(q)$ for the small sample and for the silica rod are identical within the statistical error.

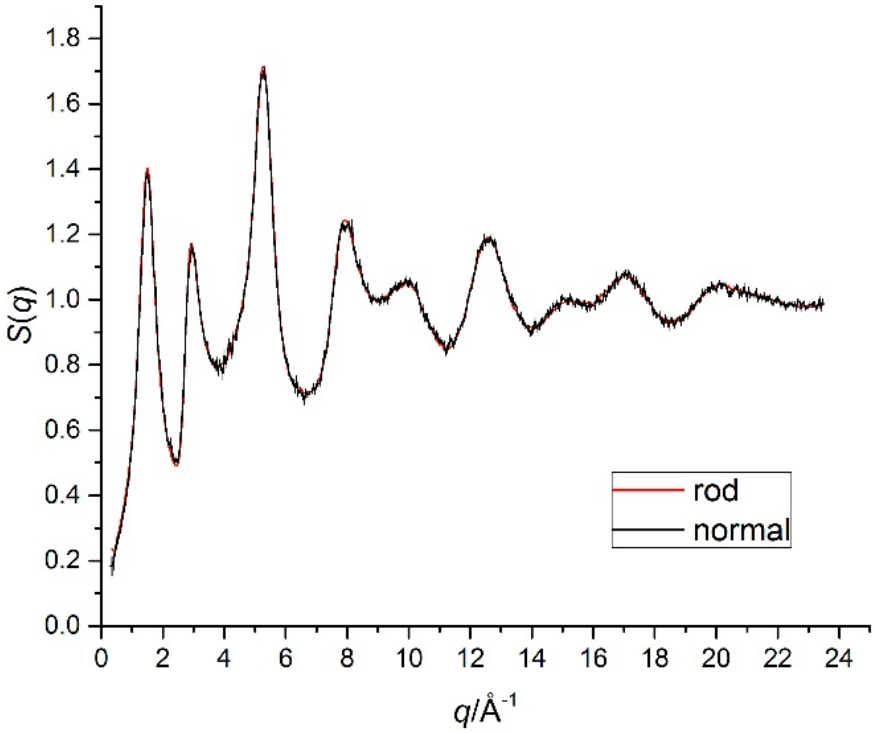

Fig. 2. The $S(q)$ function measured for a small sample of "normal" SiO_2 in a thin-walled vanadium can, compared to the $S(q)$ function measured for a "normal" SiO_2 rod in a regular scattering geometry with no container. The data sets are identical within the statistical error.