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► **To cite this version:**

Olivier Bouty, L. Ramond, K. Dardenne, J. Röthe. Two-dimensional Wide Angle X-ray diffraction on a radioactive borosilicate glass in a beryllium container. PNCS 16 - 16th International Conference on the Physics of Non-Crystalline Solids, Jul 2022, Canterbury, United Kingdom. cea-04837749

HAL Id: cea-04837749

<https://cea.hal.science/cea-04837749v1>

Submitted on 13 Dec 2024

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Two-dimensional Wide Angle X-ray diffraction on a radioactive borosilicate glass in a beryllium container

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In the context of a better characterization of alpha self-irradiation effects of incorporated nuclear waste in glass matrices for long term disposal, we present the results of an X-ray diffraction experiment on a Curium doped six-oxide borosilicate glass (ISG-C or “Cm-doped International Simple Glass”). This glass was melted in 2007 in ATALANTE facility and has already accumulated an α -decay dose greater than 7.10^{18} $\alpha.g^{-1}$, a value corresponding to a damaged but stabilized structural state.

For the first time, we managed to apply 2-D Wide Angle X-ray diffraction technique to ISG-C glass in a beryllium container. The experiment was operated on ACT beamline at KARA synchrotron (Germany), by combining a 50 keV high energy X-ray beam and an image plate. A special container filled with ISG-C glass was built using three concentric beryllium tubes nested as Russian dolls, with each tube closed at one end with a threaded cap, in order to reach safety synchrotron regulations¹.

Even if such configuration brings some drawbacks as for example large Cm fluorescence or Be crystalline contributions which partially blur the diffraction patterns, it was possible to successfully extract the structure factors of both pristine and Cm-doped glass samples. Striking new substructures appear under the so-called first sharp diffraction peak (FSDP), which cannot be explained only by already known effects related to variations in glass composition or thermal effects. It is more likely that these new sub-structures be related to changes in the size distribution of large objects like rings or chains under the influence of mixed interactions between the glass network, α -particles and recoil nuclei. All these issues will be discussed in relation with other ISG-C Raman scattering characterizations.

1. O. Bouty & al., Two-dimensional Wide-Angle X-ray Scattering on a Cm-doped borosilicate glass in a beryllium container, *J. Sync. Rad.* **28** (2021).