ESRF	**Experiment title:** **How polyamorphism of B_2O_3 is affected by noble-gas loading ?**	**Experiment number**: HC-4276
Beamline: ID20	**Date of experiment**: from: 16/09/2020 to: 22/09/2020	**Date of report**:
Shifts: 18	**Local contact(s)**: Christoph SAHLE and Emmanuelle de CLERMONT GALLERANDE	*Received at ESRF:*

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Report:

Different amorphous states with distinct local structural arrangements and physical properties can be obtained following separate preparation routes. By analogy with the term *polymorphism* in crystals, the term *polyamorphism* was introduced for these transformations in glasses, and has also important implications for liquid polymorphic phase transitions [1]. Recently, we have shown that a very surprising sizeable amount of noble gas-atoms penetrates into the silica network (~1 mole of helium per mole of silica at 6 GPa).[2-4] This surprising large solubility of helium in silica glass at high pressure is accompanied by a large decrease of the apparent compressibility. [5-6] Since the ambient B_2O_3 glass is a low-density (1.8 *vs.* 2.2 $g.cm^{-3}$ for SiO_2) network made of both BO_3 triangles and B_3O_6 boroxol rings with a free volume comparable to silica, we expect significant effects of the pressurizing fluid on the pressure-induced structural modifications of the borate network.

Due to COVID sanitary restrictions, the present experiments were carried out remotely thanks to the excellent work of C. Sahle and E. de Clermont Gallerande from the ID20 beamline. We have performed an X-ray Raman scattering experiment on ID20 on B_2O_3 glass immersed in two distinct pressurizing fluid (He and Ne) as a function of pressure. We have used a diamond anvil cell provided by ESRF and offering a large aperture. Measurements were made through Be gasket. An energy resolution as high as 0.6 eV was required in order to be more sensitive to slight changes in the pre-edge profile. As an example, the high-pressure B K-edge spectra of B_2O_3 glass immersed into He and Ne are shown on the Figure 1. We can see important modifications of the electronic structures of boron atoms induced by pressure, which are caused by severe structural rearrangements. As previously observed in the literature for pressurized v-B_2O_3 without any pressure transmitting medium [7], a threefold to fourfold-coordinated boron conversion is found in both fluids. The O K-edge spectrum experiences also important modifications with pressure, highlighting an important modification of the angular distribution of the B-O-B inter-polyhedra angle, via the $^{[2]}O$ to $^{[3]}O$ conversion. The pressure induced structural modifications of v-B_2O_3 show notable differences between He and Ne, maybe related to the larger solubility of helium in B_2O_3 glass. Further data analysis of the present XRS data and additional measurements (Brillouin Scattering) are required in order to fully describe and understand the observed modifications.

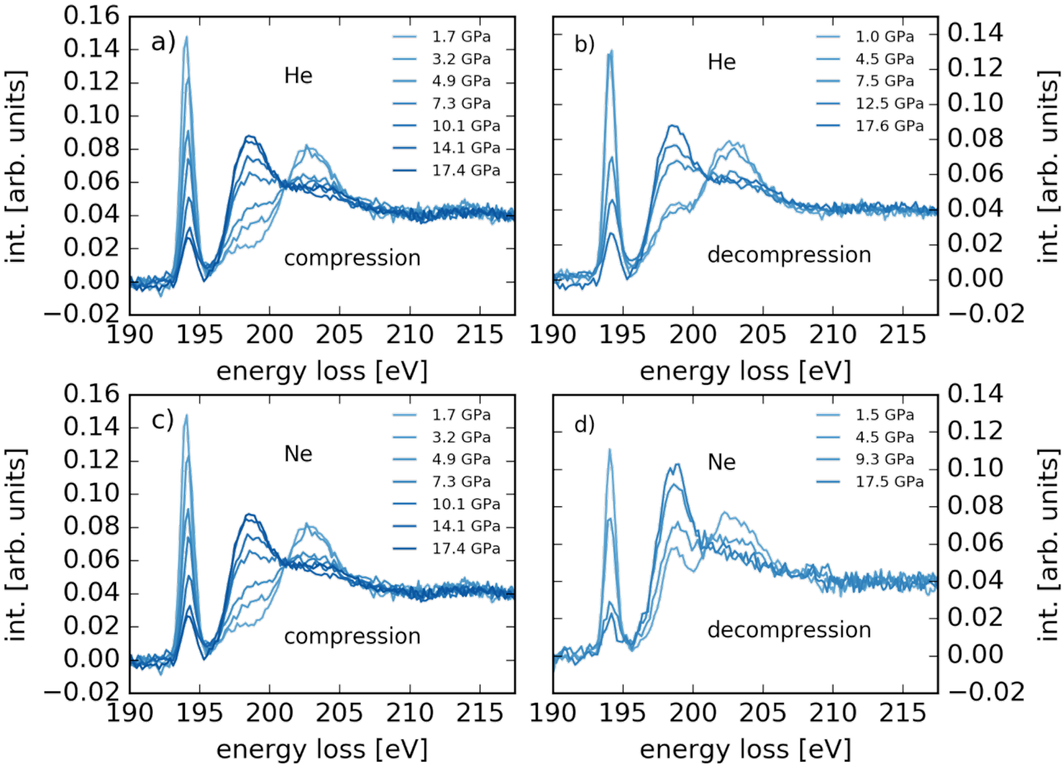

Figure 1: B K-edge XRS spectra of B_2O_3 glass immersed in two distinct pressurizing fluid (Helium (top) and Neon (bottom)) during both compression and decompression phases.

In conclusion, thanks to the great capabilities of the ID20 beamline, successful measurements have been obtained at high-pressure using a panoramic diamond anvil cell with an excellent signal to noise ratio. The observed modifications of the polyamorphic transition as a function of the pressure transmitting medium will give us new clues to understand the variations of compressibility properties.

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