Solution to beam induced dynamics in oxide glasses measured by X-ray Photon Correlation Spectroscopy

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X-ray Photon Correlation Spectroscopy is the only available X-ray scattering technique that allows investigation of slow microscopic dynamics in glasses and supercooled liquids. XPCS has been developed at synchrotrons were X-ray beams with high degree of coherence and high intensity are generated. The technique is successfully used to study structural relaxation and aging in metallic glasses at atomic length scale[1]. However, application of the XPCS to oxide glasses (SiO_2, GeO_2, B_2O_3 etc.) has revealed faster than expected relaxation times[2-4]. It is well established that the origin of the measured by XPCS fast relaxation in oxide glasses stems from X-ray irradiation effect, the higher the beam intensity the faster the relaxation time[2-4]. The beam induced effect is subtle because no modification of the static structure factor is observed during the measurements[2-4], this differs from conventional radiation damage. Yet it prevents measuring intrinsic slow relaxation in an important class of materials such as oxide glasses.
In this work we present an approach that allows estimation of the true sample's dynamics in oxide glasses. The methods requires two measurements with different intensities of the beam or at different temperatures. Using numerical simulation we demonstrate that the true slow sample's relaxation time can be estimated to a certain level which depends on accuracy of the measurements. In view of the forthcoming upgrades of the synchrotron sources[5], that promise 100 fold increase in intensity of coherent beams, the proposed approach offers a solution to the beam induced dynamics in oxide glasses.

References

[1] – B. Ruta et al. Phys. Rev. Lett., **109**, 165701 (2012).
[2] – B. Ruta et al. Scientific Reports, **7**, 3962 (2017).
[3] – G. Pintori et al. Phys. Rev. B, **99**, 224206 (2019).
[4] – K. Holzweber et al arXiv:1909.11408 (2019).
[5] – P. Raimondi Synchrotron Radiation News, **29**, 8 (2016).