

Intense x-ray beam as a trigger and probe of defects enucleation in silica-based materials

Erica Alfinelli[†]

Glasses are commonly used but yet obscure materials. The physics of glasses still misses a microscopic description of the dynamics ruling glass formation. X-ray Photon Correlation Spectroscopy (XPCS) is an established technique to probe relaxation processes in materials at the atomic length-scale and a promising method to elucidate the glass transition phenomenon. However, the x-ray beam pumps and probes at the same time the atomic displacements inside the sample in a process described as beam induced dynamics [1–3]. Radiolysis is the proposed mechanism to explain the emergence of this artificial effect: the photoelectron emitted after x-ray absorption increases the local energy and induces nearby atoms to move inside the illuminated volume. In the presentation I will show some evidences that this induced effect entails the production of permanent defects centres [4, 5]. Specifically, I will present XPCS results in v -SiO₂ and in its crystalline counterpart, α -quartz. The research in this field is essential for the next generation synchrotrons. Moreover, the large use of silicon dioxide in several branches of physics and the advent of the new devices based on phase change materials make the understanding of this phenomenon of prior importance.

References

1. Ruta, B. *et al.* Hard X-rays as pump and probe of atomic motion in oxide glasses. *Sci. Rep.* **7**, 1–8 (2017).
2. Holzweber, K., Tietz, C., Fritz, T. M., Sepiol, B. & Leitner, M. Beam-induced atomic motion in alkali borate glasses. *Phys. Rev. B* **100**, 214305 (2019).
3. Pintori, G., Baldi, G., Ruta, B. & Monaco, G. Relaxation dynamics induced in glasses by absorption of hard x-ray photons. *Phys. Rev. B* **99**, 224206 (2019).
4. CLINARD Jr, F. W. & HOBBS, L. W. in *Modern Problems in Condensed Matter Sciences* 387–471 (Elsevier, 1986).
5. Tomozawa, M. & Doremus, R. H. *Glass I: Interaction with Electromagnetic Radiation: Treatise on Materials Science and Technology, Vol. 12* (Elsevier, 2017).

[†]erica.alfinelli@unitn.it