New Opportunities to Unveil Glass Dynamics with X-ray Photo Correlation Spectroscopy at ESRF-EBS

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One of the most challenging issues in solid-state physics concerns the understanding of the process of dynamical arrest in soft materials and in molecular liquids. X-ray photo correlation spectroscopy (XPCS) is the only one technique able to probe the dynamics at the atomic length scale and over the typical time scales corresponding to the evolution towards an arrested state.

The XPCS technique in wide-angle configuration has been applied in recent years to the study of a variety of glass-formers, including oxide and metallic glasses [1-4]. We have now ample evidence that in the oxide glasses at room temperature the dynamics is simultaneously "pumped" and "probed" by the incident X-ray beam, with a linear relationship between the incident X-ray flux and the characteristic timescale of the induced dynamics [1,2]. In the case of the boron oxide glass, B_2O_3, we succeeded to show that it is possible to access the intrinsic dynamics of the system by increasing the temperature towards the glass transition [1]. In this way, the sample dynamics gets faster than that induced by the beam and thus experimentally accessible. However, the temporal window where the intrinsic dynamic is experimentally accessible is limited by the low coherent flux available nowadays.

In this contribution, I will review the main results we obtained in metallic glasses [4], where the dynamics shows pronounced ageing effects, and in various oxide glasses [1-3], where the effect of the beam is to induce an almost stationary dynamics.

I will then highlight the opportunities offered by the new ESRF-EBS source for XPCS on glasses. I will focus on the possibility to probe the atomic dynamics close to the glass transition and in complex sample environments, such as multi-anvil cells for high pressure studies.

References

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