PhD Position in Experimental Physics

Laboratoire Charles Coulomb – UMR-CNRS 5221– Montpellier University
PhD supervisors: Benoît Rufflé and Coralie Weigel
Physics of the glassy state Group
https://www.coulomb.univ-montp2.fr/-Equipe-Physique-des-Verres-

New insights into pressure-induced polyamorphism in oxide glasses

Understanding and describing the structure and properties of the glassy state poses enormous difficulties and remain a fundamental problem in condensed matter physics. However, the situation is evolving rapidly as new experimental, computational, and theoretical methods are continuously developed. Different amorphous states with distinct local structural arrangements and physical properties can be obtained following separate preparation routes. Besides these apparent continuous transformations, some glasses seem to exhibit abrupt changes between two rather different structures such as the low-density and high-density glassy phases of water or of boron oxide, *i.e.* polyamorphism. Even if this field is one of the most topical subjects of the glass physics in recent decades, it is still largely not well understood.

The present experimental PhD project proposes to use advanced spectroscopy and structural experiments at high pressure to achieve an accurate description of the microscopic mechanism of pressure-induced polyamorphism in a set of representative oxide glasses (SiO_2, GeO_2, and B_2O_3). Simple oxide glasses form an excellent playground to study polyamorphism as both intrinsic free volume and network topology effects can be addressed. As compared to tetrahedral networks (SiO_2), trigonal networks (B_2O_3) have been much less studied and contradictory results have been reported so far. An important novelty of the approach will be to compare glass samples immerged in non-penetrating pressurizing fluids like argon or nitrogen with samples immerged in penetrating fluids like helium or neon. It allows separating density from stress effects. If density-driven, it is then anticipated that gas-adsorption should induce a shift to higher pressures or even a suppression of the structural modifications. However, virtually nothing is known on these aspects which will be explored for the first time in this project. This project is further developed in close collaboration with a team at IMPMC, Paris, where numerical modeling will be carried out to complement the experiments.

Some references: C. Weigel et al., Phys. Rev. Lett. 109, 245504 (2012). B. Coasne et al., J. Phys. Chem. B 118, 14519 (2014). C. Weigel et al. Phys. Rev. B 93, 224303 (2016).

Experimental techniques: Raman and Brillouin light scattering, inelastic X-ray scattering, neutron or x-ray diffraction, high pressure, use of large-scale facilities in Europe and abroad.

How to apply

- Please send a cover letter, complete CV, copy of Diploma and reference letters to benoit.ruffle@umontpellier.fr and coralie.weigel@umontpellier.fr
- Applicant skills: M.Sc./graduate degree in solid-state physics. Basic knowledge in spectroscopy, diffraction and scientific computing is appreciated.
- The position is available for three years starting **between Oct. 2017 and Feb. 2018**.
- Funding from the French ANR.