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Glasses are a fundamental part of technology development. We find them in several industries: decoration, packing, structural functions, pharmacy, electronics, optics, telecommunications, renewable energy… The multi-disciplinary nature of these materials results evident. The combination of the microscopic disordered structure of glasses with the macroscopic mechanical properties of a solid is at the core of the long-standing importance of glasses in the industry and society. As an important example, pharmaceutical products are typically formed by crystalline drugs that are poorly water-soluble and show limited bioavailability. On the contrary, amorphous forms show improved solubility. Unfortunately, in spite of its high impact in society and industry, there is a lack of a complete and satisfactory understanding of its nature. There is no theoretical framework that completely describes glasses at a molecular level. Even the origin of the glass transition, when the viscosity of a liquid dramatically increases, is under discussion. Recently, a new methodology to produce highly stable glasses, known as ultrastable, has emerged and boosted the scientific and industrial interest on the field. This methodology is based on the growth of glasses from the vapor. In that way, glasses with stability compared to amber, aged for millions of years, are obtained. These glasses represent a new benchmark to further understand the nature of glasses, apart from its potential applications in a broad range of fields. On the other hand, an increasing number of researchers have begun to exploit pressure as an experimental variable. Over the last decade, the application of hydrostatic pressure has become a prominent strategy for resolving the glass transition puzzle. The exploration of these two advanced and innovative methodologies together may play a key role in the development of glass science and in the disentangling of the deepest questions in the glass transition community.

In this project, we propose to combine the new features observed after the study of ultrastable glasses with the advances that dielectric measurements at high pressure offer to the study of glass transition from an innovative point of view. In particular, we propose to study the influence of high-pressure in both annealing and aging processes on ultrastable glasses, in other words, how an ultrastable glass evolves when bringing them at a temperature above its glass transition (annealing) or below it (ageing), while being simultaneously at high pressure. From the obtained information, the existing theories will be complemented, or even new theories will be developed. Special features in glasses are observed when high-pressure is applied, which are not observable at normal conditions. The exposure of ultrastable glasses to high pressures may show us new phenomena, added to the different ones observed in ultrastable glasses at normal conditions. Due to the novelty of ultrastable glasses and the fact that few groups in the world are expert on the research of high-pressure properties of glasses, none of these experiments have been reported previously.

The introduction and large-scale application of glasses in important industries such as pharmaceutical or electronics would represent a huge advancement, considering the benefits of glasses compared to the crystalline counterpart (dose and toxicity in the case of pharmaceutical industry, ease of production in the case of electronic industry). It seems obvious that a clear understanding of glass science would enable the introduction of a technology which would enormously boost strategically important sectors, with its consequent impact on economy and society. A clear commitment towards the development of original and innovative research in that sense represents a great opportunity to boost the position of the European Union in this crucial topic. The recent findings in the glass community has induced the glass science to evolve into a new science, of great impact in both society and industry, which requires new professionals, with broad and inter-disciplinary perspective in order to make further progress and assure the correct implementation in the industry. The development of this project points in that direction.