

The state of matter is strongly influenced by variations in chemical composition and external parameters, such as pressure, temperature, and cooling rate, which enable material properties to be tuned. In crystals (with long-range ordering structure), pressure can promote a polymorphic structural transition from one phase to the other, while in metal glasses (with short range ordering), pressure induces densification, which results in energy activation to a higher state. There is some evidence that the densification of metal glasses enhances plasticity, which can be a milestone in developing new types of glasses.

Ultra-high pressure compression constitutes an alternative approach to transforming a viscous liquid into a glassy state leading to different thermodynamic trajectories. It allows the achievement of other glasses conditions, *described as densified glass*. The proposed project aims to apply a new thermodynamic path using ultra-high pressure (up to 100 GPa) to attain a high-density amorphous glass state for glass-forming base alloys. This path denotes isothermal compression of the supercooled liquid to reach the glass transition temperature  $T_g$ , followed by isobaric cooling.

On the one hand, our goal will be to obtain Mg–Gd and Zr–Cu-based alloys bulk metallic glasses due to the influence of high pressure on the shift in glass transition temperature and to change the critical glass forming cooling rate. Developing an appropriate chemical composition and condition parameters such as pressure, temperature, and cooling rates for producing densified metal glasses is an excellent challenge in materials science. The potential use of new materials envisaged for the project depends on their production's practical and economical method, which should be maximally optimized for obtaining components. The result of the research carried out under the project is also a process model, which in turn will allow the development of efficient technology for producing new densified glasses for applications in various branches of the industry.