Non-Equilibrium View of the Amorphous Solidification of Liquids with Competing Interactions

Magdaleno Medina-Noyola, Gabriela Carretas-Talamantes, Edilio Lázaro-Lázaro, and Jesús B. Zepeda-López

Instituto de Física, Universidad Autónoma de San Luis Potosí, México.

In this seminar we illustrate the applicability of the *non-equilibrium self-consistent generalized Langevin equation (NE-SCGLE) theory* of irreversible processes in liquids [1,2], by describing the non-equilibrium phase behavior of the "simple" microscopic model underlying van der Waals celebrated equation of state, in which the fluid particles interact through excluded volume plus attractive dispersion forces. This model finds beautiful physical realizations in colloidal systems where the attraction is due to van der Waals dispersion forces or in colloid-polymer mixtures, where attraction is provided by depletion interactions. Adding now a long-range interparticle repulsion, provided, for example, by the electrical charge of the colloids, leads to a variety of equilibrium and non-equilibrium phases. The interplay between short-range attractions and long-range repulsions (SALR) characterizes the so-called liquids with competing interaction. The theoretical description of the phenomenology associated to glassy or gel states in these systems has to take into account the presence of thermodynamic instabilities, such as that defining the so called λ line and the spinodal line [3]. Here we report the first steps in the application of the NE-SCGLE theory, to the description of the dynamical arrest processes that occur in these systems when instantaneously quenched into state points lying in regions of thermodynamic instability. The predicted theoretical scenario reveals an amazing interplay between these thermodynamically-driven instabilities that favor equilibrium macro- and micro-phase separation, and the kinetic arrest mechanisms that favor the non-equilibrium amorphous solidification of the liquid into an unexpected variety of glass and gel states.

References

[1] P. E. Ramírez-González and M. Medina-Noyola, Phys. Rev. E **82**, 061503 (2010).
[2] J. M. Olais-Govea, L. López-Flores, J. B. Zepeda-López, and M. Medina-Noyola, Scientific Reports **9**, 16445 (2019).
[3] A. J. Archer, Phys. Rev. E **78**, 031402 (2008).