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PREFACE

Dynamically slow processes and near-arrest phenomena in soft matter

Professor Francesco Mallamace.

Guest Editor

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The aim of this special issue is to summarize what has been learnt by both the network (the Marie Curie Research and Training Network on Arrested Matter) and the broader international community on dynamically slow processes and near-arrest phenomena. Another aspect of this special issue is to highlight new directions in which dynamical slowing down is, or may be, important. In particular, this issue is dedicated to a member of this network, Professor Francesco Mallamace, who reached the venerable age of 60 in 2008.

Professor Francesco Mallamace is one of the group leaders of the complex materials and systems worldwide network. In particular he is a pioneer who has successfully investigated aggregation phenomena and the dynamics of colloids, and the properties of water in the deeply supercooled phase region. The scientific activities of Professor Mallamace are mainly experimental, making use of different scattering and spectroscopic techniques. He is a very active and well-known scientist not only for his research but also for training young scientists by organizing many international networks, congresses and schools. Under his influence, mainly by taking advantage of large international collaborative activities, the University of Messina has become one of the major European centers for complex systems.

Among the invited speakers to the final conference of the network, we have collected the following 11 interesting articles. In this special issue, we roughly classify the papers according to three major groups: the first four papers deal with the theory and experiments on the dynamic crossover phenomena in general glass-forming liquids, the next four papers deal explicitly with slow dynamics in supercooled confined water and the last three papers deal with the interpretation of the near-arrest phenomena in colloids.

Chong *et al* used an extended mode coupling theory, which includes the hopping effect, to predict a dynamic crossover at T_c in the α-relaxation time and in the self-diffusion constant explicitly.

Chen *et al* demonstrated with experiments, simulations and the extended mode coupling theory that a genuine change of dynamical behavior of both water and many glassy liquids happens at the crossover temperature T_L, which is 10–30 % higher than the calorimetric glass transition temperature T_g.

Medina-Noyola and Ramírez-González propose a theory to describe the irreversible diffusive relaxation of the local concentration of a colloidal dispersion that proceeds towards its stable thermodynamic equilibrium state, but which may in the process be trapped in meta-stable or dynamically arrested states.

Kushima, Lin and Yip used the energy landscape picture to demonstrate that all supercooled liquids should exhibit two transitions: a strong-to-fragile crossover at low viscosity range, and a fragile-to-strong crossover before the glass transition temperature.

Stanley *et al* explore recent progress in understanding the 63 anomalies in liquid water, by combining information provided by recent experiments and simulations on water in bulk, nanoconfined and in biological environments.

Buldyrev *et al* study the phase behavior of particles interacting through pair potentials with a hard core plus a soft repulsive component. The presence of the two repulsive length scales may be the origin of unusual phase behavior such as polyamorphism, both in the equilibrium liquid state and in the glassy state.

Franzese *et al* study the dynamics of water confined between hydrophobic flat surfaces at low temperatures and at different pressures. The different behaviors of water can be understood in terms of the hydrogen bond dynamics.

Kumar *et al* use molecular dynamic simulations of a TIP5P water model to investigate the effect of hydrophobic confinement on the anomalies of liquid water. In particular, they studied water around proteins and DNA and found that sharp changes in structure and dynamics of water upon crossing the Widom line drives the glass transition in biomolecules.

Tartaglia studies the kinetics of formation of branched loopless structures in mixtures of particles with different shapes and functionalities, with appropriate Smoluchowski rate equations, including condensation and fragmentation terms.

Fierro, Coniglio *et al* describe the sol–gel transition by introducing an order parameter and its fluctuations. It appears that the dynamical transition associated to gelation is a real thermodynamic transition as it happens in spin glasses.

Medebach, Glatter *et al* discuss the photon correlation spectroscopic studies of dense oil-water emulsions and demonstrate experimentally that there is no real structural arrest transition in these systems.

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