Design of glasses with controlled diffusion properties

Dr Johan Mattsson

Disordered glassy solids are important in a wide range of technologies as well as in nature. For instance, to produce glassy polymer-based batteries that have sufficient ionic conductivity and are safe have long been a Holy Grail in battery research. Also, in the preservation of foods and to efficiently store biological matter such as proteins or cells, glass-forming hydrogen bonding carbohydrate based glasses are generally used and glassy mixtures of water and hydrocarbons are found in atmospheric aerosols in clouds. For all these materials, a common denominator is that their properties and function are strongly affected by the ability of small molecules or ions to diffuse through the glassy matrix. Diffusive motion is coupled to the molecular motions and interactions within the matrix, but we lack a proper understanding for the connection between diffusion and glassy properties both for molecular and polymeric systems. A better grasp of the underlying physics will allow the design of custom glasses for energy materials, biological or food storage and lead to a better understanding of atmospheric processes that affect our climate. This experimental project will study the interrelation between molecular relaxation, interactions and diffusion and include a wide range of advanced experimental techniques including scattering, dielectric spectroscopy, rheology, NMR, calorimetry and microscopy.

You will work with Drs. Johan Mattsson, Michael Ries and Peter Hine in the Soft Matter Physics Group in the School of Physics and Astronomy. You will work in an international dynamic research environment characterised by close collaborations between experimentalists and theorists and an inspiring mix of fundamental and applied research.

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