**Dynamics in polymer nanocomposites**

Polymer nanocomposites offer the potential to create new type of hybrid materials with unique thermal, optical or electrical properties. Understanding their structure, phase behavior and dynamics is crucial for realizing such potentials. In this work we provide an experimental insight into the dynamics of such composites in terms of the temperature, wave vector and volume fraction of nanoparticles, using multi speckle synchrotron x-ray photon correlation spectroscopy measurements on gold nanoparticles embedded in polymethylmethacrylate. Our temperature and wave vector dependent XPCS measurements provides new insight into the complex dynamics in these systems and, for the first time, reveals possible existence of a dynamical heterogeneity length scale intrinsic to PNC systems. Our results also indicate why it is important to study various aspects of thermo-mechanical properties of various PNC systems to obtain an understanding of their processibility and possibly even mechanical integrity. In turn these information could determine their ultimate usefulness or otherwise in various possible applications exploiting their multi-functionality, as alluded to in the introduction.

The experimental results discussed above are on the based on the following publications.