

# **SHEAR CONTROLLED NUCLEATION AND CRYSTAL SIZE DEFINITION IN LOW MOLAR MASS COMPOUND / POLYMER MIXTURES**

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Crystallisation from solution is a core technology in the major areas of the chemical industry and it is the critical initial step in most scientific programmes including proteins and drugs. The process of nucleation by which embryonic crystals form within a supersaturated solution remains largely understood. With synthetic polymers, such control transforms unprepossessing commodity materials into high performance components with applications in every sphere of human endeavour.

In this work, we explore how a polymer matrix impacts on the crystallisation of a low molar mass solute. In particular, we quantify how shear flow modifies the crystallisation behaviour of the low molar mass solute.

We have used time-resolving synchrotron based x-ray scattering techniques to follow the processes of crystallisation in these solute/polymer solvent systems. The small-angle and wide-angle x-ray scattering data is completed by neutron scattering measurements and electron microscopy.

We find two very interesting results. The first is that by using the appropriate polymeric solvent and shear flow history we can control and define the crystallisation of the low molar mass solute. In particular we can shift the effective temperature of nucleation and crystal growth. Secondly, we find that shear flow can be used to develop a narrow size distribution of the solute crystals such that the standard deviation of the distribution is  $\sim 8-9\%$  of the mean. In otherwords, appropriate shear flow control enables the preparation of a narrow dispersion of nanoparticles.

We have developed a model which provides an understanding of these two novel effects and enables us to identify the key parameters. It is also most interesting to compare and contrast the mechanisms for those proposed for the crystallisation of the polymers themselves.