Poster Presentation

MS115.P08

Accessing polymorphs by a thermal gradient approach

Basab Chattopadhyay[1], Yves Geerts[1]
[1]*Université Libre De Bruxelles, Brussels, Belgium*
E-mail: basab.chattopadhyay@ulb.ac.be

Polymorphism can be defined as the intrinsic ability of a solid material to exist in two or more crystal forms which may differ in the molecular conformation and/or crystal packing. It is linked to the unpredictability of crystal structures from the first principles as polymorphs differ only in energy ≤ 10 KJ/mol. The phenomenon is generally understood in terms of nucleation, i.e. once a nucleus of a given phase has appeared, growth continue in the same phase without any subsequent phase transition. Due to its dramatic influence on material properties, polymorphism is of great importance for industrial sectors like pharmaceuticals, fertilizers, explosives, pigments, and organic electronics. Although an extensive body of research is available in this topic, some elements key to the understanding of polymorphism is still missing. (Jones, 2016) To this extent we sought to understand the role of heat flux in polymorphic control and phase transitions (Schweicher, 2011) with a model system, acetaminophen. This is experimentally facilitated by a temperature gradient heating stage which essentially consists of two independent heating elements separated by a distance of 2.5 mm. One of the heating elements is set at a temperature, above the melting temperature (hot side) while the other at a temperature below the crystallization temperature (cold side) of acetaminophen. Structural evolution is then followed as thin films of acetaminophen are translated from the hot zone to the cold zone. Thin films are ideal model systems, because of the absence of convection, heat transport occurs only by diffusion. In this presentation, we report on the crystallization of polymorphs of acetaminophen as a function of thermal gradient parameters (magnitude of the gradient, sample velocity) in a thin film geometry. The thin film samples were displaced at a given rate ($1 \leq v \leq 75$ μm/s) to control direction and the rate of crystal growth. This allows to decouple nucleation and growth. (Schweicher, 2012) A detailed structural analysis combining polarized optical microscopy (POM) and X-ray diffraction (out-of-plane, in-plane) has been carried out to characterize different crystalline forms produced by the thermal gradient technique. The resulting polymorphic forms have been found to have high phase purity and exhibit remarkable stability over time.

[1] Jones, A. O. F. et al. (2016) Adv. Funct. Mater. 26, 2233–2255.
[2] Schweicher, G. et al. (2011). Cryst. Growth Des. 11, 3663–3672.
[2] Schweicher, G. (2012). PhD thesis, Universitié Libre de Bruxelles, Brussels, Belgium.

Keywords: Thermal Gradient, Growth, Nucleation