IFPRI Project Abstract

Investigating the Effect of Solvents and Impurities on Crystal Growth

Michael F. Doherty and Tobias Mazal
University of California Santa Barbara
Project Start Date: 1 September, 2017
Abstract Date: 25 May, 2020

Project Objective:

The goal of this research is to develop a practical engineering tool for predicting the relative growth rates (growth kinetics) and morphology of solution-grown faceted crystals, including the effects of solvent, and impurities/additives. The methodology will be tested on a variety of systems, including: paracetamol, olanzapine, ammonium acetate and a variety of drug substances, all grown from solution.

Approach:

Our approach is to leverage many years of research & development building our crystal design software tool called ADDICT. Our approach is to develop (fast) mechanistic models of crystal growth validated by experiments and both molecular simulations and KMC simulations.

Recent Results:

We have developed a Kinetic Monte Carlo simulation that is being used to test our mechanistic growth models for crystallization from solution. Testing is complete for the case of pure solvent with no impurity and results agree well the mechanistic models, which in turn agree well with morphology predictions for crystals with simple growth units (centrosymmetric growth units, such as naphthalene and rubrene solutes). The KMC simulations have been extended to include impurities in solution ("growth inhibitors") adsorbed onto the crystal terraces (crystal surface in front of the moving steps). We are in the finishing stages of testing conventional growth inhibition models relative to the KMC results.

Next Steps:

We will spend the next year completing our testing and making any appropriate modifications to the mechanistic models. These will then be incorporated into ADDICT.