Nucleation of One Polymorph by Another

Contrary to standard view, crystallization is not always defined by the initial nucleation. In each of the systems shown to the left, the fast-nucleating structure grows slowly, allowing a fast-growing structure (new polymorph) to nucleate on it and dominate the product. The phenomenon expands the classes of nucleation:

1. **Heterogeneous nucleation of a crystalline phase**
   - Induced by foreign particles (composition fully different)
   - Induced by crystals of the same composition
   - Induced by crystals of partially the same composition (e.g., hydrate on anhydrate)

2. **Cross-nucleation**
   - and the same phase (e.g., “growth-front nucleation” in polycrystalline growth)
   - and a different phase (e.g., “Cross-nucleation between polymorphs”)

3. **Cross-nucleation**
   - Initial phase is growing. New phase must grow faster, can be more or less stable
   - Initial phase is not growing. New phase must be more stable, can grow at any rate

Cross-nucleation has very different kinetics from other types of nucleation. Data shown are for D-mannitol.