Functional Crystallization Technology using Periodic Macrofluidic Flow

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Taylor vortex and Batchelor vortex flows are typical periodic microfluidic motions induced in the gaps between coaxial cylinders and disks, respectively, when the one part is rotated while the other part is stationary. For last several decades in my lab, the Taylor and Batchelor vortex flows have been used for development of crystallization technology for accurate control of fundamental phenomena such as crystal growth, polymorphic nucleation, phase transformation, agglomeration, crystal size distribution, deracemization. In crystallization of sulfamerazine and L-histidine, the polymorphic nucleation strongly depended on the fluid motion. As such, the stable nucleation was directly induced in the Taylor vortex flow whereas the metastable nucleation was followed by the stable nucleation in the turbulent eddy flow. The temperature-gradient Taylor vortex was highly effective for phase transformation and control of crystal size distribution due to the internal loop of temperature cycling. In addition, the co-crystallization and spherical agglomeration were highly promoted in Batchelor vortex and Taylor vortex flows due to their unique patterns of fluid motion.