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Inertially Stabilized Microfluidic Crystals: Self-assembly and Spatial Frequency Tuning WONHEE LEE, HAMED AMINI, UCLA, HOWARD STONE, Princeton university, DINO DI CARLO, UCLA — Dynamic self-assembly can be found over a wide range of scales originating from different fundamental opposing forces. By taking advantage of inertial effects we demonstrate controllable self-assembling particle systems at the microscale. Inertially focused particles in confined high-speed microfluidic channel flows dynamically self-assemble into uniformly spaced lattices through purely hydrodynamic interactions with no external force fields. Focusing on the dynamics of the particle-particle interactions reveals a mechanism for the dynamic self-assembly process; inertial lift forces and a parabolic flow field act together to stabilize interparticle spacings that otherwise would diverge to infinity due to viscous wakes. The interplay of the repulsive viscous interaction and inertial lift also allow us to design and implement microfluidic structures that irreversibly change interparticle spacing, similar to a low-pass filter. Although often not considered at the microscale, nonlinearity due to inertia can provide a platform for high-throughput passive control of particle positions in all directions, which will be useful for applications in flow cytometry, tissue engineering, and synthesis of metamaterials.

Wonhee Lee
UCLA

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