Colloidal molecules made with microfluidics

Joshua Ricouvier[1], Patrick Tabeling[1]

[1]Gulliver, ESPCI ParisTech, Paris, France

*joshua.ricouvier@espci.fr

In the field of colloidal science, the efforts undertaken over the last ten years have led to design a variety of colloidal structures with a potential to serve as building blocks for new materials. However, the most promising methods used for creating building blocks, being based on bulk techniques, achieve high throughputs, but, in the meantime, suffer from limitations in terms of control, dispersity, process complexity, yield, and ranges of shapes. We discovered a novel strategy, using microfluidics, for designing colloidal building blocks with both high throughput and control.

Our strategy is based on the entrainment of droplets in microfluidic channels, where the droplets spontaneously aggregate and rapidly rearrange into an ensemble of well-defined structures. The physical origin of the phenomenon is a coupling between depletion forces and droplet-droplet dipolar interactions. By varying the flow parameters, we succeed in designing a wide array of building blocks such as chains, triangles, diamonds, tetrahedrons, and heterotrimers. These well-controlled structures possess geometrical, chemical, and/or magnetic anisotropies, which enable directional bounding. The liquid clusters can be photo-polymerized in situ and produced via a continuous flow process. The particles of the solidified clusters are tightly held together by sub-micrometric polymerized cords attached in-between them. We believe that this robust and inexpensive method could meet the demand for the efficient production of colloidal building blocks for various applications.

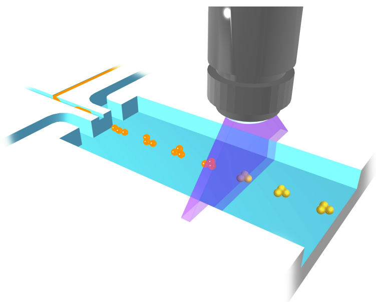

Figure 1 Schematic diagram of microfluidic device used to produce building blocks

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