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Juggling with droplets

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We employ monodisperse emulsions to compartment liquids for microfluidic processing. If the volume fraction of the continuous phase is small, the dispersed compartments (droplets) assemble into well-defined arrangements, analogous to foam. Hence, the position of a single droplet within an ensemble of droplets is fully determined while being transported through microfluidic channels. We demonstrate an in-situ method for the production of such monodisperse emulsions and pairs of droplets, suitable for microfluidic processing. A variety of channel geometries is explored for passively and actively positioning, sorting, dividing, and selectively coalescing of droplets in a ‘lab-on-chip’ style processing. These techniques are applied to study (bio-) chemical reactions to grow fibrin networks in droplets and probe their mechanical response, to synthesize noble metal doped silica particles with very large internal surface area for heterogeneous catalysis, and to use the well defined arrangements of the emulsion lamellae in foam like topologies to study membrane properties.