**Vortex fluidic controlled self-assembly and growth of nanoparticles**

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The vortex fluidic device (VFD) imparts mechanical energy into thin films of liquid in a controlled way under continuous flow conditions, and this can be harnessed for the bottom up growth of nanocrystals and nanoparticles involving self-assembly processes, along with the ability to probe the structure of self-organized systems.1-5 Such control can be achieved by systematically exploring the parameter space for the thin film microfluidic platform, including the tilt angle of the rapidly rotating tube, , flow rate, choice of solvent, targeting solvents with high sustainability metrics, concentration, temperature, and field effects, in particular magnetic, UV-vis, NIR, electric and plasma.

The dynamic thin film in the VFD has high heat and mass transfer, with Faraday waves on the surface of the liquid. The fluid flow in the VFD is complex, and details of this will be presented, along with controlling the size, shape, morphology and aggregation of nanoparticles, for a diversity of materials, Figure 1. Processing in a rotating tube (typically 20 mm diameter as quartz or borosilicate glass, 19 cm long) lends itself for real time monitoring as a powerful tool for understanding the mechanism of particle growth, as a feedback loop for further optimizing the processing. This monitoring thus far includes UV-vis, fluorescence, thermal imaging, Raman and small angle neutron scattering (SANS). An example here is the formation of liposomes of phospholipids, studied using real time SANS, with solutions passing through the VFD above the critical concentrating (milky solution) affording liposomes ca 100 nm in diameter, as now a clear solution, with the ability to directly load small molecules.



Figure 1. Schematic of the vortex fluidic device (VFD) and some different shapes that can be generated, depending on the material, at the sub-micron dimensions.

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