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High shear thin film fabrication of nanocarbon

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Thin film microfluidics is developing for a wide range of applications, and includes the synthesis of various types of nanocarbon material, involving both 'top down' and 'bottom up' continuous flow processing. Such processing addresses scalability at the inception of the science, and is applicable not just to the synthesis of nanocarbon, but also composites or hybrid material where one or more components is nanocarbon. We recently developed the vortex fluidic device (VFD) as a thin film microfluidic platform where the liquid is subjected to shear stress (mechanical energy) in a rapidly rotating tube. The shear stress offers scope for controlling the shape, morphology and size of carbon nanomaterial, with the prospect of high green chemistry metrics of the processing. Applications of the VFD are many and varied, and for nanocarbon we have established (i) the formation of toroidal arrays of SWCNTs with control over their diameter, (ii) the slicing of SWCNTs, DWCNTs and MWCNTs while the thin film is irradiated with a 1064 nm wavelength pulsed laser, in the absence of harsh chemicals, exfoliation of graphite, and (iii) assembling fullerene C60 into nanotubules in the absence of surfactants. Other aspects of composite structures of nanocarbon generated in the VFD for both confined mode and continuous flow mode will be presented.

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