Aerodynamically Assisted Jetting: Pressure Driven Approach for Processing Nanomaterials

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Aerodynamically assisted jetting (**AAJ**) is a novel jet-based approach driven by a pressure difference, which is capable of handling concentrated nano-suspensions for drop and placing nanomaterials within droplet residues.

The generation of a near mono-dispersed distribution of droplets depends on the applied pressure difference over the aerodynamic orifice (between the chamber and the outlet) and flow rate of the nano-suspension. Several suspensions containing a wide range of nanomaterials (as particles: SiO_2, silicone, fullerenes, quantum dots to nanotubes, single, double, multiwalled to bamboo type) can be processed using this jetting approach.

The internal diameter of the needle accommodating the flow of nano-suspensions is sized at 0.35 mm. The exit orifice, which is centrally in line with the axis of the needle, has a diameter of 0.35 mm that has been counter sunk externally. The counter sinking allows the jet to have a much smaller diameter when passing through the exit orifice. The needle is connected to a high-precision syringe pump. (Fig.1)

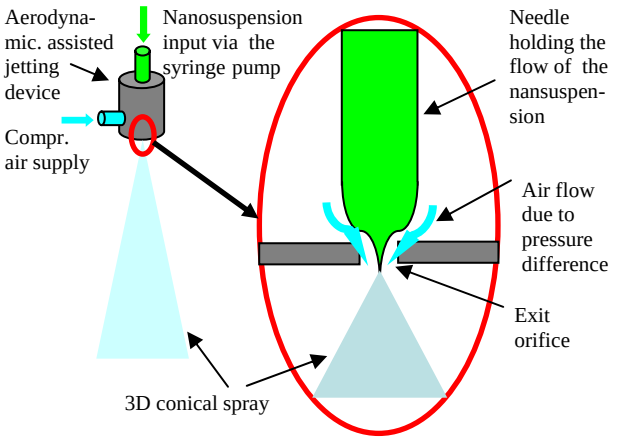

Fig. 1 AAJ equipment. Schematic representation.

During the experiments either the applied pressure to the chamber or flow rate has been kept constant while the other has been varied to understand the effect on both the jetting of the polymer and the generated droplet sizes. Wide operating spaces for both have been studied. Beneath are some examples of the investigations:
Carrying out the optimisation studies on the ethylene glycol alone it has been established that for a liquid flow rate in the order of ~$10^{-9}m^3s^{-1}$ and for a pressure flow rate of ~2L/min the jet has was stable and generated a near mono-distribution of droplets (Fig.2a).

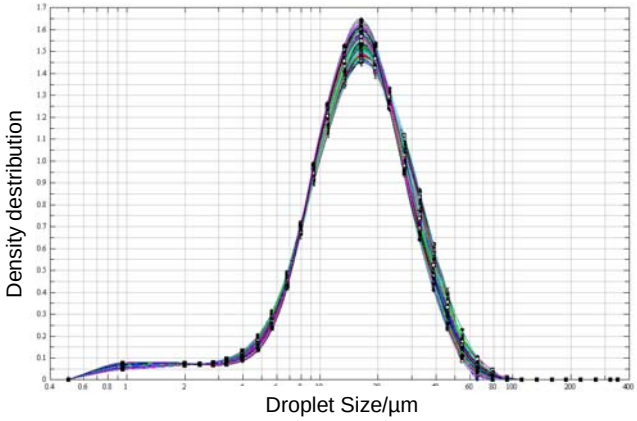

Fig. 2a Ethylene glycol alone

Keeping these operating conditions, the media has been changed to the none-suspension containing SiO_2 particles. The generation of near mono-distribution has been similar but the pick of the droplet sizes has been shifted to the right (Fig.2b).

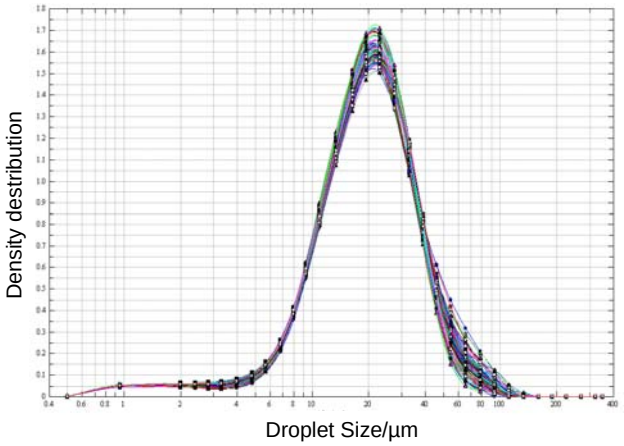

Fig. 2b SiO_2 particulate-based nano-suspension.

Generally, the novel pressure-driven jet technology is a powerful materials process fabrication tool capable to generate the finest possible near mono-dispersed droplets containing nanomaterials.

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