Aerodynamically Assisted Jets: A Paradigm for Directly Microbubbling and Microfoaming Combinations of Advanced Materials

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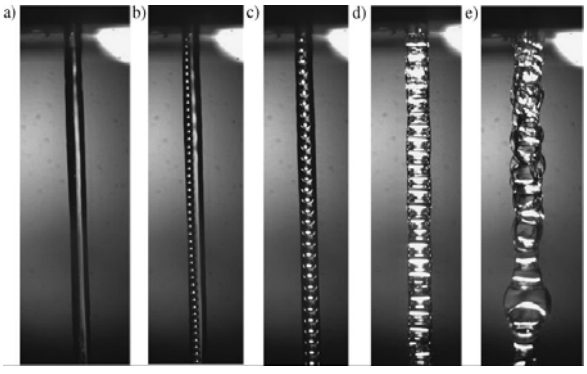
Aerodynamically assisted jetting is a phenomenon exploring the formation of liquid jets, which subsequently generates a myriad of droplets. Until recently this technique was only investigated for process of droplets producing.

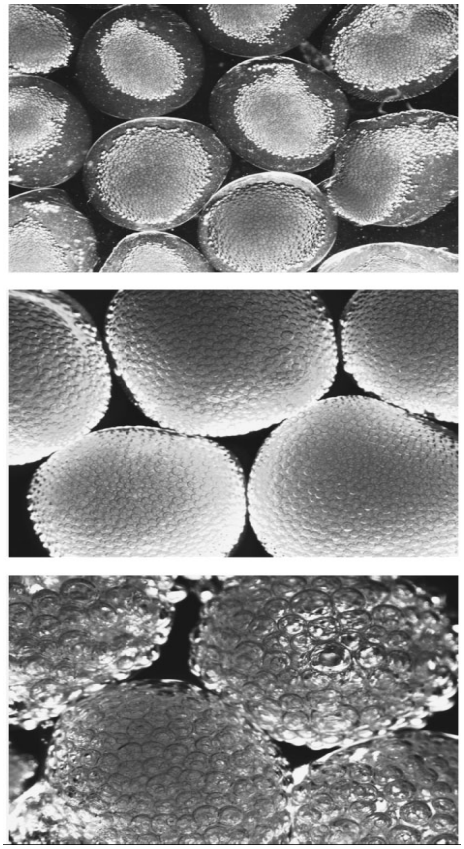
In the recent investigations the technique has been substantially developed. Firstly, the suspensions have been containing a wide range of mammalian living cells. Secondly, the technique allows the formation of micro bubbles and micro foam by means of retrofitted approach. Microbubbles and microfoams are tremendously useful structural entities having a plethora of applications in regenerative and therapeutic medicine. Thirdly, the studies show that the process of microbubbling and microfoaming is controllable by increasing / decreasing the flow rate / air pressure. Thus it is possible to control bubble diameter distributions. See the picture below where different applied pressure rates are represented; Pictures a-c demonstrate stable and picture e - unstable micro-bubbling / micro foaming.



Applied pressure a) 0.10 bar; b) 0.15 bar; c) 0.25 bar; d) 0.3 bar; e) 0.4 bar

At the certain flow rate it is possible to generate large bubbles containing micro/nanomaterials or living cells. Further increasing of flow rate has disturbed microbubbling / microfoaming by the introduction of polydisperse distribution whereas decreasing of flow rates forced bubbles to escape the encapsulation process and generate chaotic structures, which are most undesirable.

The picture below demonstrates typical optical micrographs of the multi-composition structures at different applied pressures.



It has been displayed the ability to handle a multi-component suspension containing micro / nanomaterials combined with living cells. It is also possible to convert this approach into a high-throughput method by incorporating the arrays of needles and thus increasing production volumes. The authors noted, however, that the cell densities varied from structure to structure.

Generally, these new structural entities could be useful to tissue engineering, regenerative medicine and controlled and targeted cellular advanced therapeutics.

This flyer is based on the following publication:

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