

SCALING OF LINEARLY ALIGNED ELECTROSPRAYS

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We aim to develop robust geometries based on the stacking of one dimensional (1D) linear electro spray arrays. In 1D geometries the electric field lines easily focus onto the end of the electro spray injectors (“needles”), allowing electro spraying at moderate electric potentials without assistance from extractor electrodes. In addition, solvent vapor is easily removed from the spray area, a requirement for making particles by droplet drying.

Our contribution is a comprehensive study of how the spray plumes geometry and the stability of the Taylor cones scale as a function of the array geometry parameters. We investigate also system configurations that consider end electrodes and their effect on the expansion of the deposition spots. The use of end electrodes was suggested by Rulison and Flagan (1993) for 1D - arrays, and by Deng *et al.* (2006) for 2D arrays.

Figure 1(a-b) show example collections (“spots”) of polymeric particles from 3- and 5-needle linear arrays with an inter-needle pitch of 5 mm. In going to 5 needles, the deposition spots compress strongly along the array direction, but not in the traverse direction. The spots also are smaller because of the 8 % higher electric potential needed for sustaining Taylor cone stability. In the 5-needle case, the separation between the central 3 spots is already close to the inter-needle pitch, namely the theoretical minimum spacing. A general view of the system with 3 sprays and 2 end electrodes is depicted in Figure 1(c). Figure 2 shows the effect of the number of needles and the number of end electrodes on the geometry of the spots.

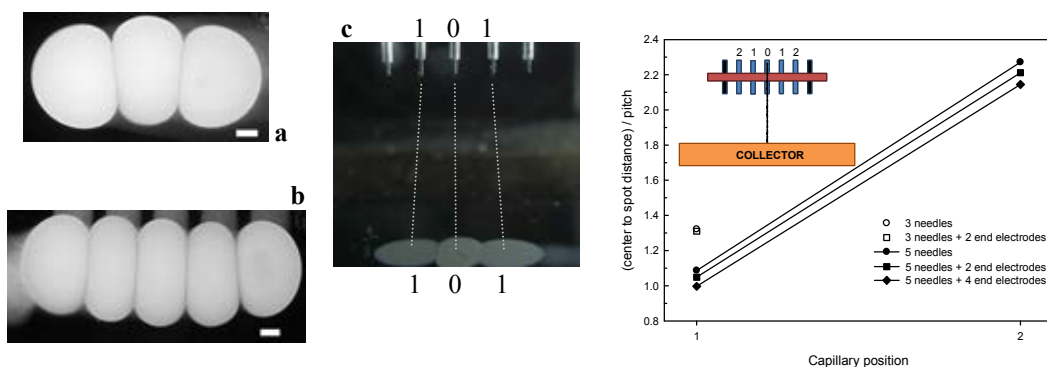


Figure 1. (a)-(b) Collected ‘Spots’ of ethyl cellulose particles from 3 and 5 needle arrays after a 3 min. collection. Scale bars are 2 mm long. (c) Spots produced by 3 functional needles + 2 end electrodes (in this case, non-spraying needles) and spot numbering.

Figure 2. Distance from the center-of-area of each collected spot to the center, normalized by inter-needle pitch, as a function of capillary position (inset), for different configurations of the linear array.

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References

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