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Nanobubbles for Nanofiber Fabrication

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Nanobubble is observed in everyday life and widely used in MEMS[1,2], yet only recently that we are beginning to apply the nanobubble dynamics to nanofiber fabrication[3].

Nanofibers produced by electrospinning are already being used in a vast array of products in many industries[4-10]. However, the volume of production of nanofibers has been being a bottleneck restricting their applications. A novel method to fabricate continuous and uniform nanofibers with high-throughput is much needed.

We suggest a bubble-electrospinning using an aerated polymer solution in an electric field[3]. Multiple jets, which are a prerequisite for increasing the volume of production, are found in this electrospinning process.

In classical electrospinning process, the surface tension of the electrospun solution is a major factor affecting the morphology of the nanofibers and its electrospinability. Not every polymer can be prepared for electrospinning[3], generally speaking solutions of polymers with a too low or too high molecule weight cannot be electrospun into continuous fibers. Electrospinability mainly depends upon the solution viscosity, which is intrinsic character of the solution can not be changed much.

Now thing is changed, the surface tension of a bubble does not depend upon solution properties but its size. Consider a bubble made by a polymer solution, and assume that the air pressures inside and outside the bubble are respectively P_i and P_0, its radius is r.

The surface tension of the bubble, T, can be expressed as[11]

$$T = \frac{1}{2} r(P_i - P_0) \tag{1}$$

Although the maximal or minimal size of a bubble might depend upon the solution viscosity, the surface tension of bubbles is independent of properties of the spun solutions, such as viscosity, which is the main obstruction in traditional electrospinning. The devised method must be much economical, so this might be the beginning of a new materials revolution.

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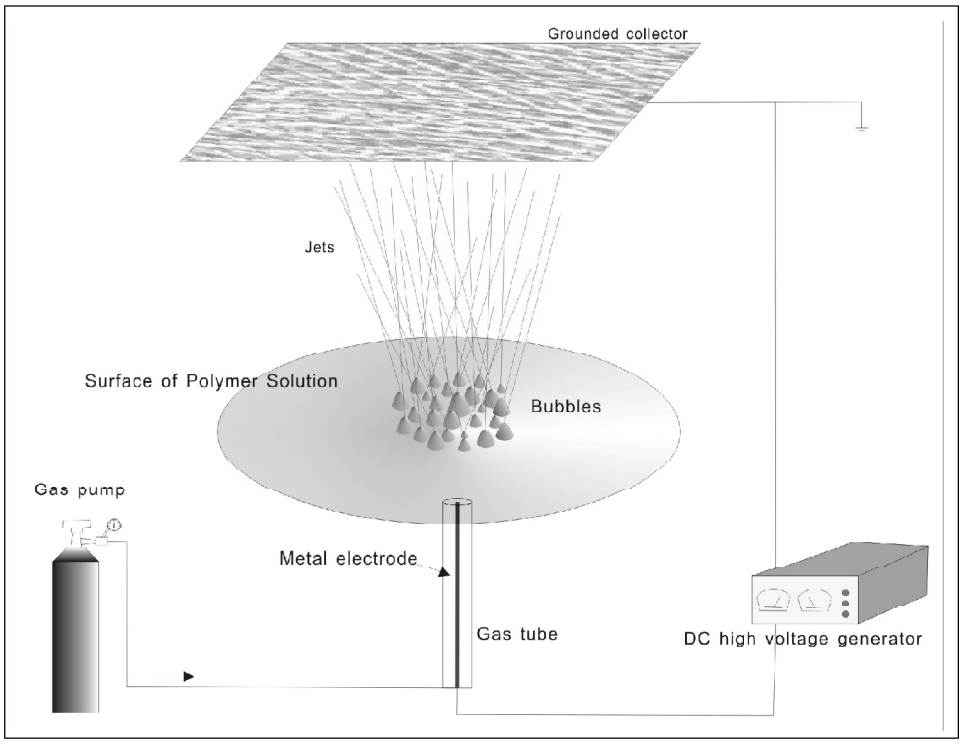

Figure 1: Principle of the Bubble-electrospinning

Figure 2: Multiple Jets Ejected from an Aerated Polymer Solution in a Electronic Field

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