Free Surface Electrospinning

Keith M. Forward and Gregory C. Rutledge
Dept. of Chemical Engineering
Massachusetts Institute of Technology
phone: (1) 617-253-6484
e-mail: kforward@mit.edu

***Abstract*— The needle-based electrospinning process has led to the production of novel fibrous materials with the capability to impact a broad array of fields such as filtration, tissue engineering, drug delivery systems, nanocomposites, and textiles. However, as conventionally practiced, production rate of electrospinning is rather low, with the smaller diameter fibers of greatest interest generally being produced at the lower production rates. For this reason, it is often assumed that electrospun materials are limited to small volume applications. To remedy this, several variations of a process we call "free surface electrospinning" have been proposed to increase the production rate of electrospun fibers. In all of these processes, jets are initiated from the free liquid surface without the use of a needle or nozzle, which creates a greater areal density of electrospinning jets compared to conventional "needle electrospinning". To illuminate the key parameters for operation and scale-up of free surface electrospinning, we report the results of a series of experiments performed using a bench-top apparatus and a commercial unit, the Elmarco NS Lab®. In these studies, we considered "drop-on-fiber" systems where a wire (with diameter on the order of hundreds of microns) was passed through a polymeric solution and a uniform thin film formed on the wire. We present characterization of both the droplet breakup process and the subsequent jetting phenomenon.**