Liquid spray is essential to industries requiring processes such as spray coating, spray drying, spray pyrolysis, or spray cooling. This thesis reports the design, fabrication, and characterization of a thin film deposition system which utilizes a linear multiplexed electrospray (LINES) atomizer. First, a thorough review of the advantages and limitations of prior multiplexed electrospray systems leads to the design rationale used in this work. Next, the line of charge model was extended to prescribe the operating conditions for the experiments and to estimate the spray profile. The spray profile was then simulated using a Lagrangian model and solved using a desktop supercomputer based on Graphics Processing Units (GPUs). The simulation was extended to estimate the droplet number density flux during deposition. Pure ethanol was sprayed in the cone-jet mode through a 51-nozzle LINES device and the resulting aerosol was characterized using Phase Doppler Interferometry (PDI), which showed less than 3% relative standard deviation in the D10 average droplet diameter across the nozzle array. Finally a 25-nozzle LINES was integrated with a heated, motion controlled stage, to deposit TiO2 thin films onto silicon wafers from an ethanol based nanoparticle suspension. The resulting deposition pattern was analyzed using SEM, optical profilometry, and macro photography. The deposition pattern was also compared with the numerical simulation. The LINES tool developed here is a step forward to enabling the power of electrospray for industrial manufacturing applications in clean energy, health care, and electronics.

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The public is welcome to attend.