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Atmospheric Pressure Low Temperature Plasma System for Additive Manufacturing MATTHEW BURNETTE, DAVID STAACK, Texas AM University — There is growing interest in using plasmas for additive manufacturing, however these methods use high temperature plasmas to melt the material. We have developed a novel technique of additive manufacturing using a low temperature dielectric barrier discharge (DBD) jet. The jet is attached to the head of a 3D printer to allow for precise control of the plasma's location. Various methods are employed to deposit the material, including using a vaporized precursor or depositing a liquid precursor directly onto the substrate or into the plasma via a nebulizer. Various materials can be deposited including metals (copper using copper (II) acetylacetonate), polymers (PMMA using the liquid monomer), and various hydrocarbon compounds (using alcohols or a 100% methane DBD jet). The rastering pattern for the 3D printer was modified for plasma deposition, since it was originally designed for thermoplastic extrusion. The design constraints for fill pattern selection for the plasma printer are influenced by substrate heating, deposition area, and precursor consumption. Depositions onto pressure and/or temperature sensitive substrates can be easily achieved. Deposition rates range up to 0.08 cm^3/hr using tris(2-methoxyethoxy)(vinyl)silane, however optimization can still be done on the system to improve the deposition rate. For example higher concentration of precursor can be combined with faster motion and higher discharge powers to increase the deposition rate without overheating the substrate.

Matthew Burnette
Texas A
M University

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