Atmospheric Pressure Plasma Jet as a Dry Alternative to Inkjet Printing in Flexible Electronics

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Abstract
We have developed an atmospheric pressure plasma jet printing system that works at room temperature to 50 deg C unlike conventional aerosol assisted techniques which require a high temperature sintering step to obtain desired thin films. Multiple jets can be configured to increase throughput or to deposit multiple materials, and the jet(s) can be moved across large areas using a x-y stage. The plasma jet has been used to deposit carbon nanotubes, graphene, silver nanowires, copper nanoparticles and other materials on substrates such as paper, cotton, plastic and thin metal foils.

Plasma Jet Multi-Material Printer

- Nanocolloids, organic materials etc. transported as aerosol by carrier gas
- Precise control over thickness and morphology
- Ability to tailor material properties in situ (chemical, electronic)
- Can be combined as an in-line manufacturing process in additive manufacturing

Plasma Jet Printed Electronics

In-situ Tailoring of Material Properties

Cu L edge XAS
No post processing, No pre-post thermal treatment
Printed using same colloid

Cross sectional SEM of Cu(1) on Silicon(2)

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(1) Three US Patent applications pending
(3) Ram P. Gandhiraman et al., ACS Appl Mater Interfaces. 2014, 6, 20860
(5) https://www.sciencedaily.com/releases/2016/03/160322120038.htm