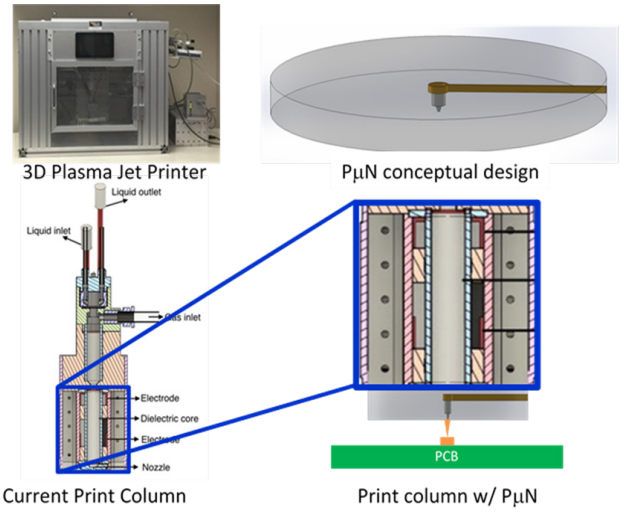
PLASMA MICRONOZZLE (PμN)

FOR HIGH-RESOLUTION, MULTI-MATERIAL 3D PLASMA JET PRINTING

Patent Pending
SD 14959.1
Technology Readiness Level: 2
Technology concept and/or application formulated

A micronozzle adapter capable of printing line widths and thicknesses 10x finer than existing 3D plasma jet printers

Heightened interest in next-generation printable and flexible electronics is accelerating research and development in rapid and highly repeatable additive manufacturing (AM) processes and capabilities. Plasma jet printing, which converts a desired print material into a low temperature plasma for deposition, is well positioned for electronics manufacturing due to its ability to print a wide range of materials onto diverse surface materials from a single platform. However, a key limitation of existing plasma jet printers is their large minimum printed line widths (150-200 μm), which makes achieving the small spot sizes and high print resolutions needed for advanced electronics more difficult. Advancements are needed in plasma jet printing to attain finer line geometries.



The plasma micronozzle (PμN) will mate with existing plasma jet printer nozzles as an adapter attachment.

Sandia researchers have developed a micronozzle adapter capable of printing line widths and thicknesses 10x finer than existing 3D plasma jet printers. This MEMS-based printhead adapter consists of silicon-on-insulator (SOI) wafer technology and was developed using additive manufacturing and microfabrication techniques. The adapter uses lensing electrodes to focus the plasma beam and control the deposition spot size. With its ability to print fine-resolution metallic inks as well as carbon, ceramic, and plastics, Sandia's plasma micronozzle adapter enables the printing of smaller and finer electronic features, such as high-density chip copper interconnects, integrated circuit (IC) packages, and integrated conductors.

TECHNICAL BENEFITS

- MEMS-based print-head adapter
- Compatible with existing commercial 3D plasma jet printers
- Prints 10x finer line widths (10-15 μm) than existing technologies
- Prints a wide range of materials, including carbon, metals, polymers, and ceramics
- Single platform offers simplified operations and extended run times for commercial applications

INDUSTRIES & APPLICATIONS

- Advanced manufacturing
- Aircraft/aerospace
- Semiconductor manufacturing
- Computing
- Electronics
- Grid/utility
- Medical devices
- Microelectronics

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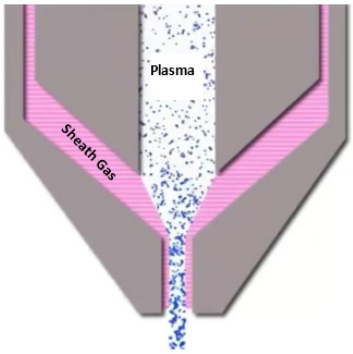
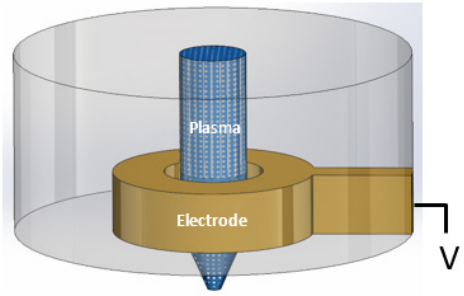
ADDITIONAL FIGURES

Microfluidic μNozzle



A sheath gas focuses the plasma into a tight beam.

Electromagnetic μNozzle



A sudden change of voltage gradient focuses the aperture lens

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