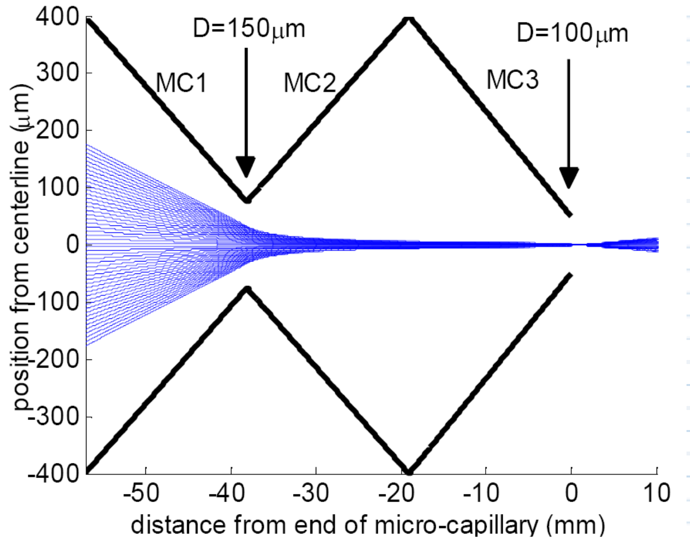
NDSU RESEARCH FOUNDATION

Non-Confidential Description

Collimated Aerosol Beam Assembly Delivers Printed Lines under 5 Microns

Technology Case: RFT-223

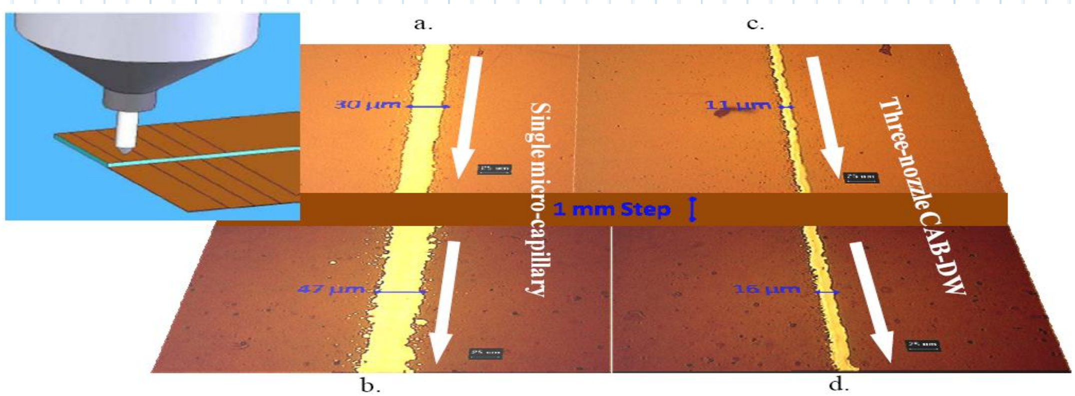


Invention Summary

Scientists at North Dakota State University have developed a micro-capillary system capable of generating a collimated aerosol beam (CAB) in which aerosol particles stay very close to the capillary center line. This novel CAB nozzle allows for aerosol beams with consistent diameters as thin as 1 micron, and <u>printed lines of less than 5 microns</u>! The CAB nozzle works on the premise of connecting three micro-capillaries in series: a linearly *converging* micro-capillary (MC1), followed by a linearly *diverging* micro-capillary (MC2), followed by another linearly *converging* micro-capillary (MC3). This arrangement, shown in the illustration above, produces maximum particle focus by the time the aerosol beam exits the third micro-capillary.

Single Micro Capillary vs. NDSU Three-Nozzle Design

Figure: *Printed silver (Ag) lines produced via aerosol deposition of nanoparticle inks using: a single-micro-capillary deposition head with a standoff distance of (a) 2.0 mm and (b) 3.0 mm; and a three-nozzle CAB direct write (CAB-DW) head with a standoff distance of (c) 2.0 mm and (d) 3.0 mm. The* ***average*** *line width of the deposited features is shown in blue.*



Benefits

- **GREEN TECHNOLOGY!** Minimal line width and overspray reduces material waste, and is ideally suited for solar cell creation.
- Minimum beam-width of 1 micron. Printed lines of 5 microns or less.
- Beam remains collimated 1 to 5 millimeters past nozzle exit.
- Surface roughness and features induce minimal line-width variance.

NDSU GREEN TECH

- Narrow lines minimize the shadow on solar cell collectors, maximize internal reflection of light back to solar cell.
- Features applied with aerosol beams will not crack thin silicon wafers like screen printing.
- Capability to print a wide variety of inks including: nanoparticle metal and polymer dispersions, organic and inorganic precursor solutions, and liquid silanes (for example, Si_6H_{12}).
- Application areas include solar cells, printed electronics, aerosol concentration, direct materials deposition, in-flight material processing, and any other application requiring an aerosol micro-beam.

Patents

This technology is patent pending with a US patent application, and is available for licensing/partnering opportunities.

The Inventors

Dr. Doug Schulz, Senior Research Scientist, Center for Nanoscale Science and Engineering
Justin Hoey, Research Engineer, Center for Nanoscale Science and Engineering
Dr. Iskander Akhatov, Professor, College of Engineering and Architecture
Dr. Orven Swenson, Associate Professor, Physics Department

Center for Nanoscale Science and Engineering (CNSE)

The disclosed collimated aerosol beam technology was developed by the team at NDSU's Center for Nanoscale Science and Engineering (CNSE). CNSE, established in 2002, conducts large-scale, multidisciplinary research for government and industry. Located in a state-of-the-art research facility in the NDSU Research & Technology Park, CNSE employs approximately 65 full-time staff, and 80 part-time students and faculty researchers. CNSE's Research 2 facility includes 77,000 square feet of cleanroom, laboratory and engineering spaces that house its design, synthesis, fabrication, and characterization capabilities. Core competencies include wireless miniaturized electronics design and prototype fabrication, research on polymeric and hard protective coatings, and materials for electronics and energy conversion.

Inquiries

Jonathan Tolstedt, Licensing Associate/Patent Agent
NDSU Research Foundation, Fargo, ND 58108-6050
Phone: 701-231-8173 Fax: 701-231-6661
Email: jtolstedt@ndsurf.org
Web: www.ndsuresearchfoundation.org