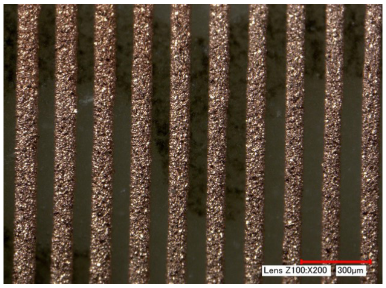
ADDITIVELY MANUFACTURED (AM)

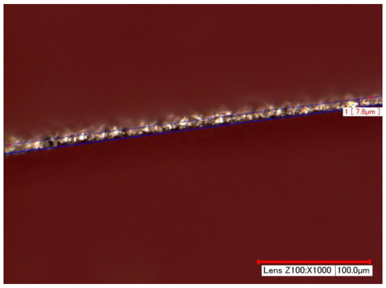
HIGHLY CONDUCTIVE, HIGH RESOLUTION ELECTRICAL TRACES AND COMPONENTS

Patent Pending
SD 15427, 15496
Technology Readiness Level: 3
Analytical and experimental critical function and characteristic proof-of-concept

A two-step additive manufacturing approach for forming highly conductive, high-resolution electrical traces and components with properties suited for flexible and hybrid electronics

Electrical traces and conductive components are essential features of electronic devices, power electronics, and printed circuit boards. Specific characteristics such as trace width and thickness can greatly influence device performance factors such as interference, signal integrity, and cost. Emerging trends in advanced electronics are creating new demand for high conductivity components that can be formed over varied or uneven surfaces. To date, high resolution (10 micron) traces have been produced with aerosol jet printing (AJP) but so far these methods cannot achieve the conductivity needed.





Above: Copper coated Ag lines deposited after 3 hours. Below: Cross-section of printed traces shows a thickness of 8-microns

Sandia researchers have developed a two-step additive manufacturing (AM) approach for printing high resolution, highly conductive traces using aerosol jet printing (AJP) and electroplating processes. In the first step, an aerosol jet printer (AJP) makes multiple passes to deposit a thin layer of conductive seed material. In the second step, the seed layers are subject to an electroplating process to refine the desired bulk and thickness of the electrical traces. The high-resolution, printed metallic materials may include additional freestanding, stretchable, and/or flexible features as desired. This new method overcomes existing barriers in AJP methods and offers a promising pathway for diverse commercial applications such as forming transformers, producing radio frequency (RF) interconnects and antennas, printed electrodes, and more.

TECHNICAL BENEFITS

- Conformal printing
- Direct printing of fundamental trace feature sizes from 10 to 100 μm
- Achieves 100-fold decrease in trace resistance for transformer components and multi-level interconnects (Cu onto printed Ag, 8-micron thickness)
- Improved conductivity and uniformity
- Tunable properties- freestanding, stretchable, flexible, and high resolution
- Reduced energy losses

INDUSTRIES & APPLICATIONS

- Aircraft and aerospace
- Advanced and additive manufacturing of electronics and microelectronics
- Consumer electronics
- Electrical grid
- Security and defense
- Power electronics and components

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ADDITIONAL FIGURES

Above: A composite stitched optical microscopy image of a plated transformer winding with constant potential deposition @ -0.5V.

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