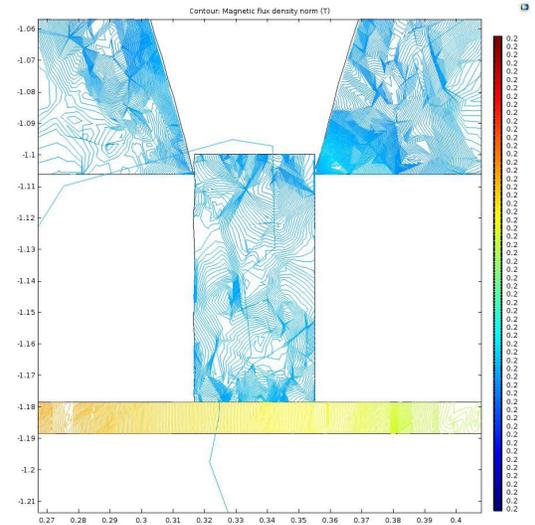


US Patent 11,084,211  
SD 14128  
Technology Readiness Level: 3  
*Concept demonstrated analytically or experimentally*

## A customized printhead for safe and high-quality additive manufacturing of exotic and piezo-responsive materials

Recent adaptations to fused deposition modeling (FDM) additive manufacturing (AM) techniques have created pathways for the printing of exotic materials, including those that are electrically or magnetically oriented or chemically endo or exothermic. AM printing of piezoelectric materials in the form of sensors is potentially useful for the areas of integrated and personal smart devices in industries from aerospace to bioscience; however, factors such as material degradation, arcing, and burning during fabrication continue to present barriers for production scale efforts.

Sandia researchers have developed a customized printhead for safe and high-quality additive manufacturing of piezo-responsive materials. The customization fits existing FDM printers. It features a printhead extrusion nozzle formed of a semi-conductive material (such as micro-machined silicon) with a channel that allows print material to exit onto a build plate. This capacitor mitigates arcing between the extrusion nozzle and the build plate. Arc suppressing gas can be introduced into the print region for further mitigation. This customized printhead introduces a capability that falls outside the scope of existing techniques geared more specifically for metals or thermoset polymers. Its application can help unlock further exploration of a new domain of AM for applied materials.



*Cross-section of an AM printhead leveraging magnetic materials*

### Technical Benefits

- Mitigates burning and arcing during FDM forming of piezo-responsive materials
- Option to dispense arc-suppressing gas at the nozzle for direct polymerization of materials
- Inhibits material degradation
- Improves safety

### Industries & Applications

- Sensors and piezoelectric devices for diverse applications
- Aerospace
- Additive manufacturing
- Consumer electronics
- Medical devices
- Smart/intelligent materials

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