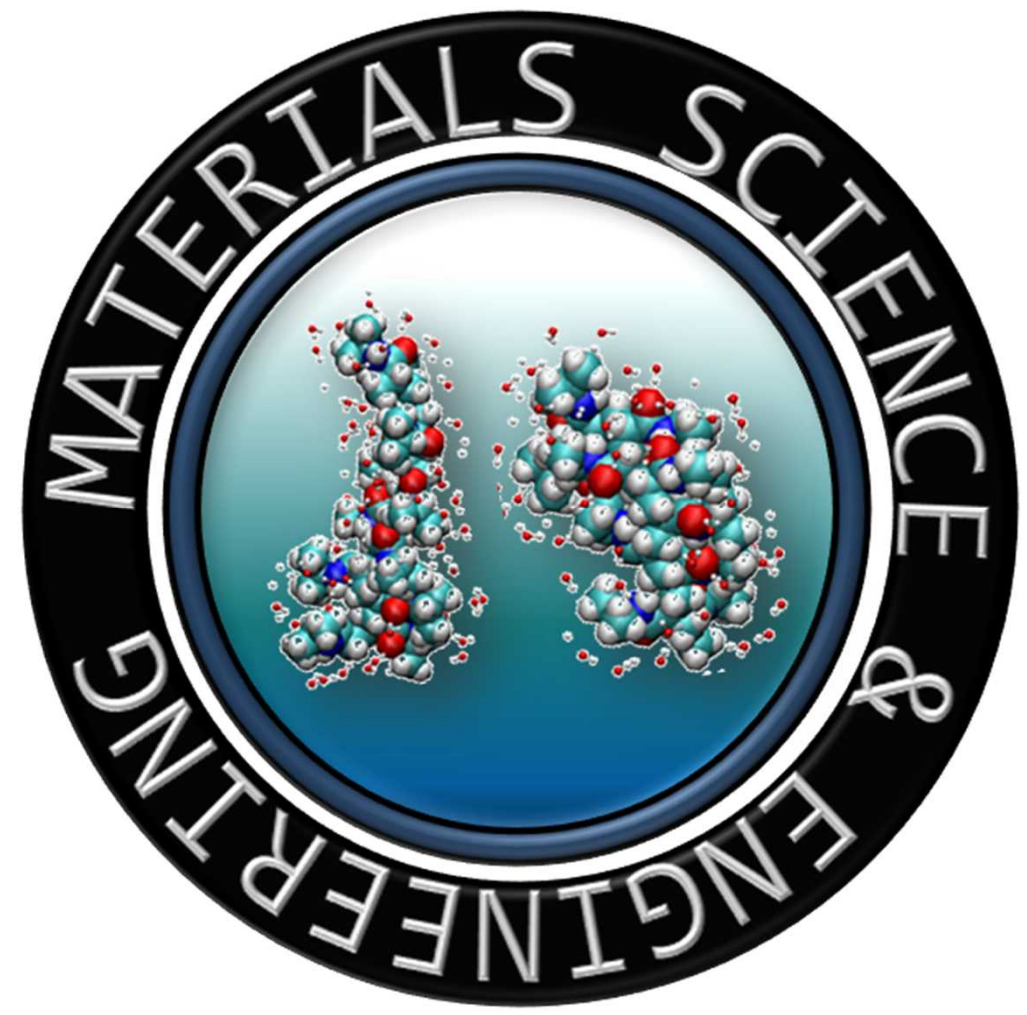
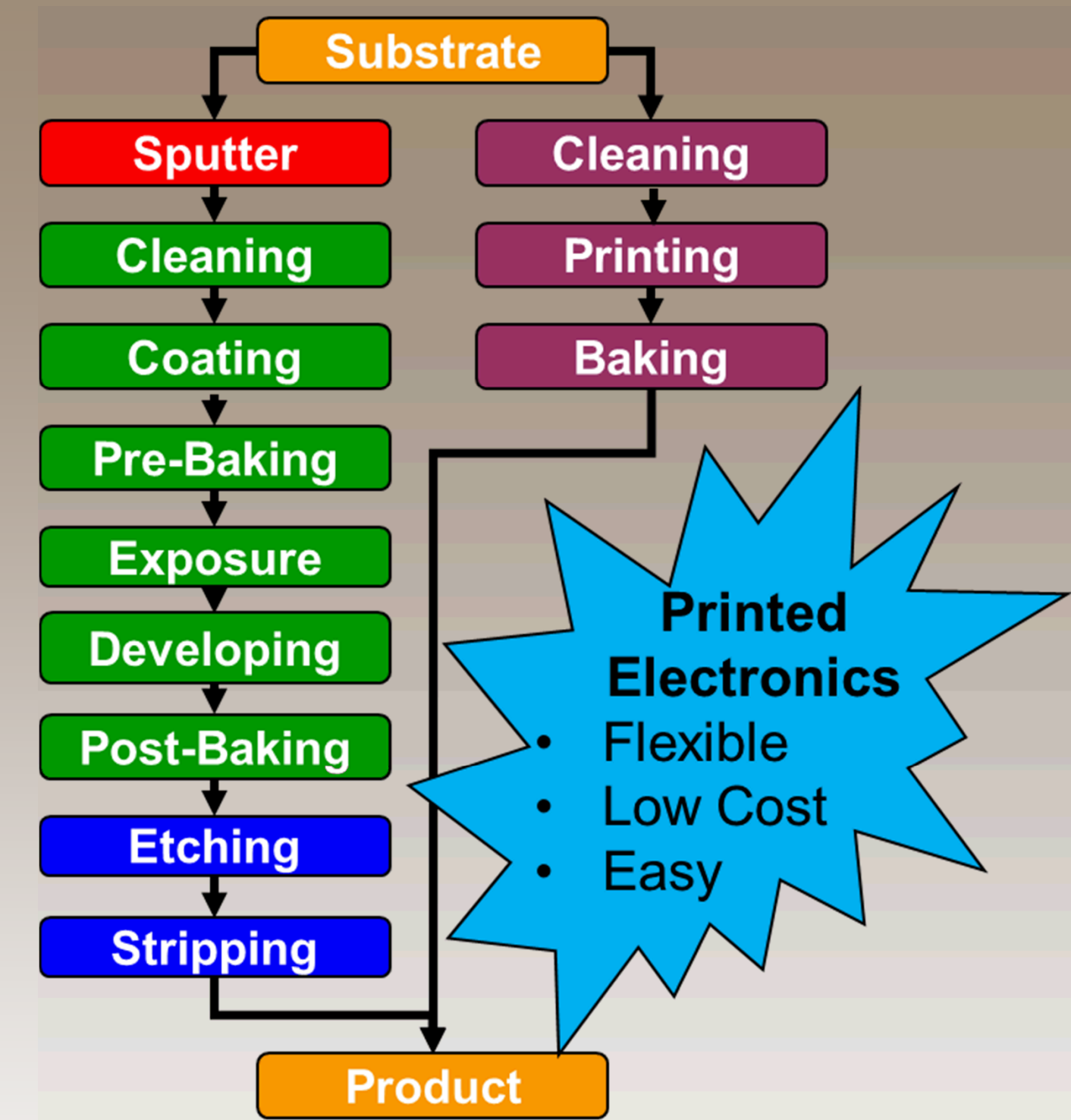
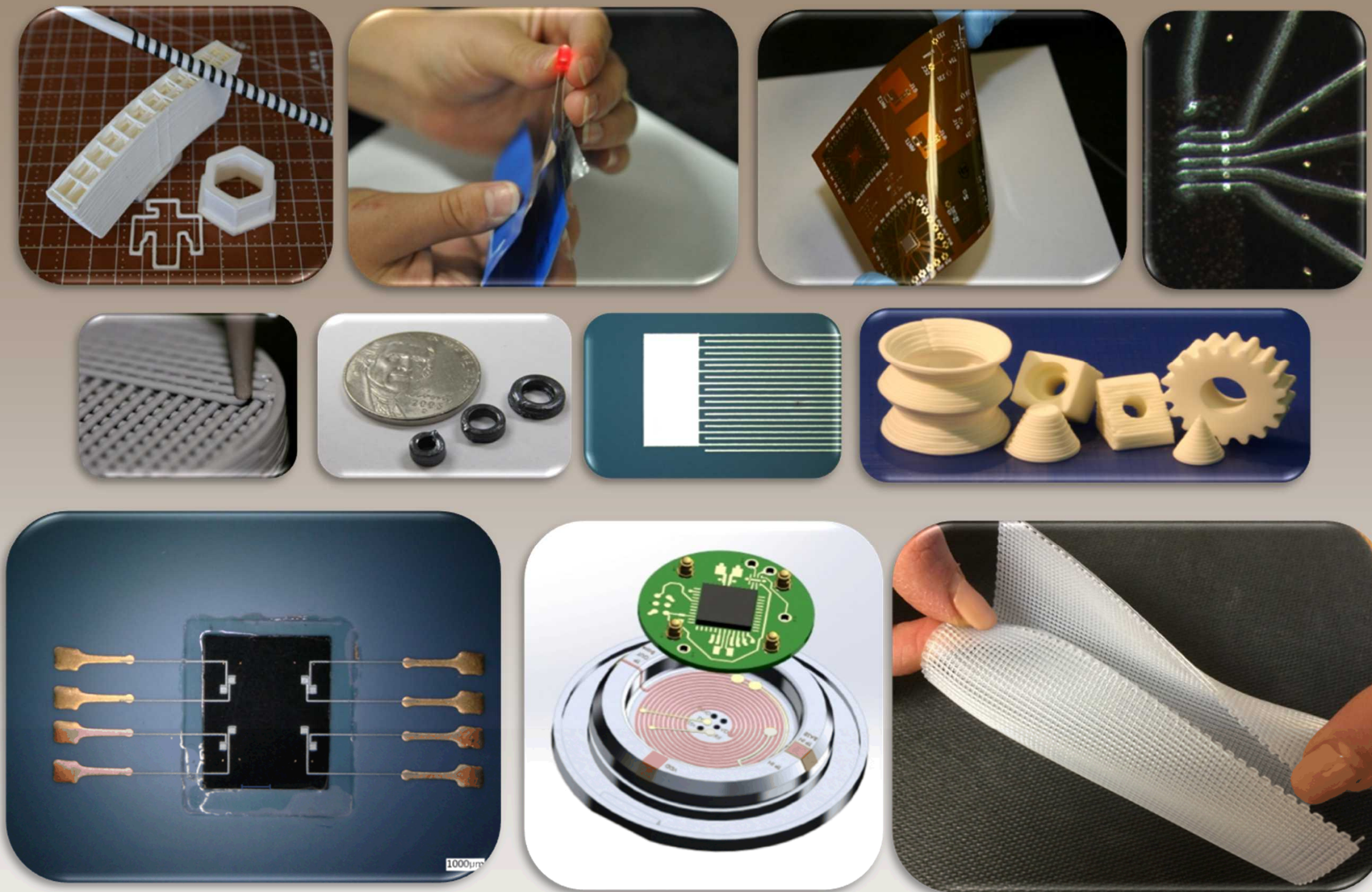


Exceptional service in the national interest

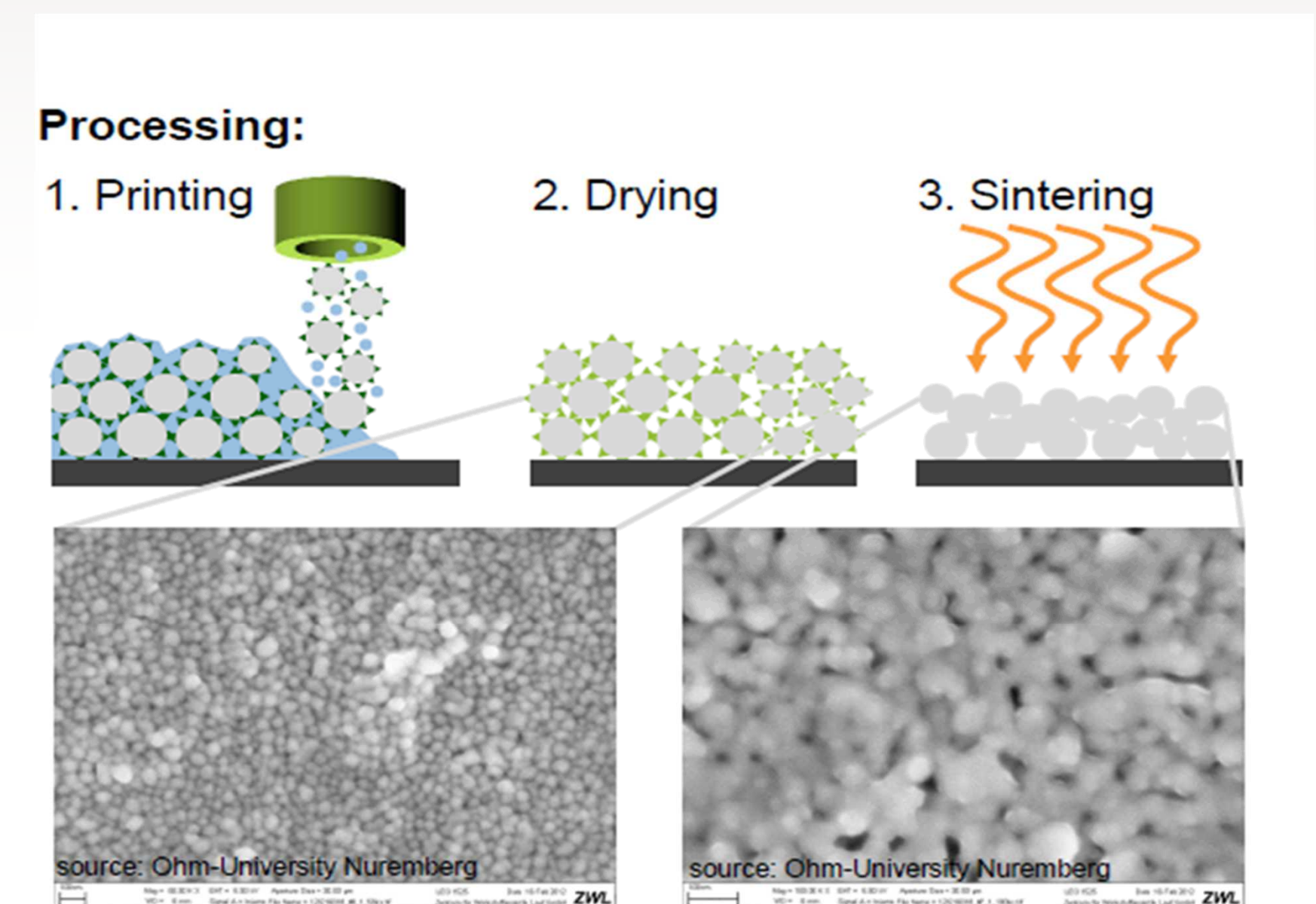
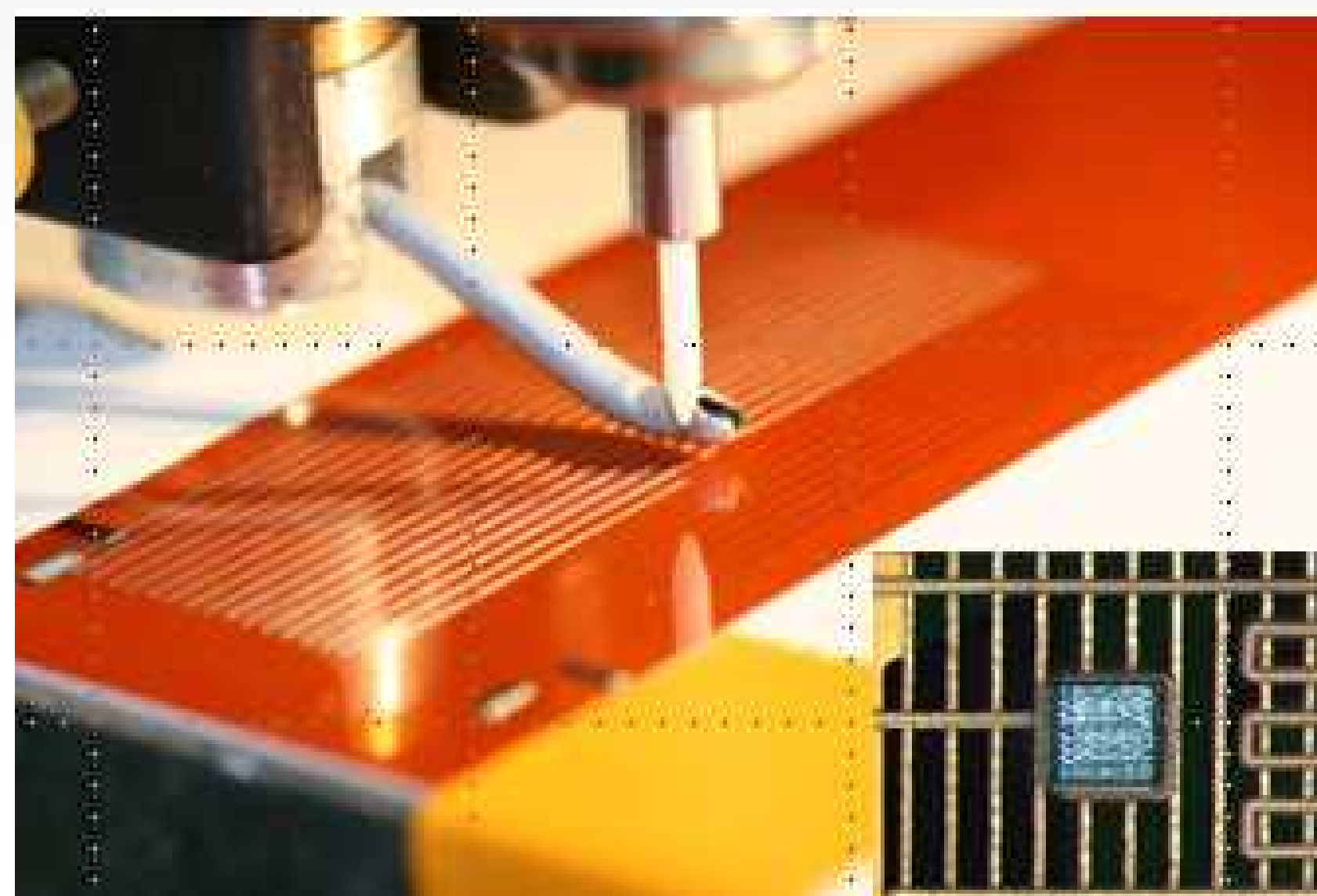
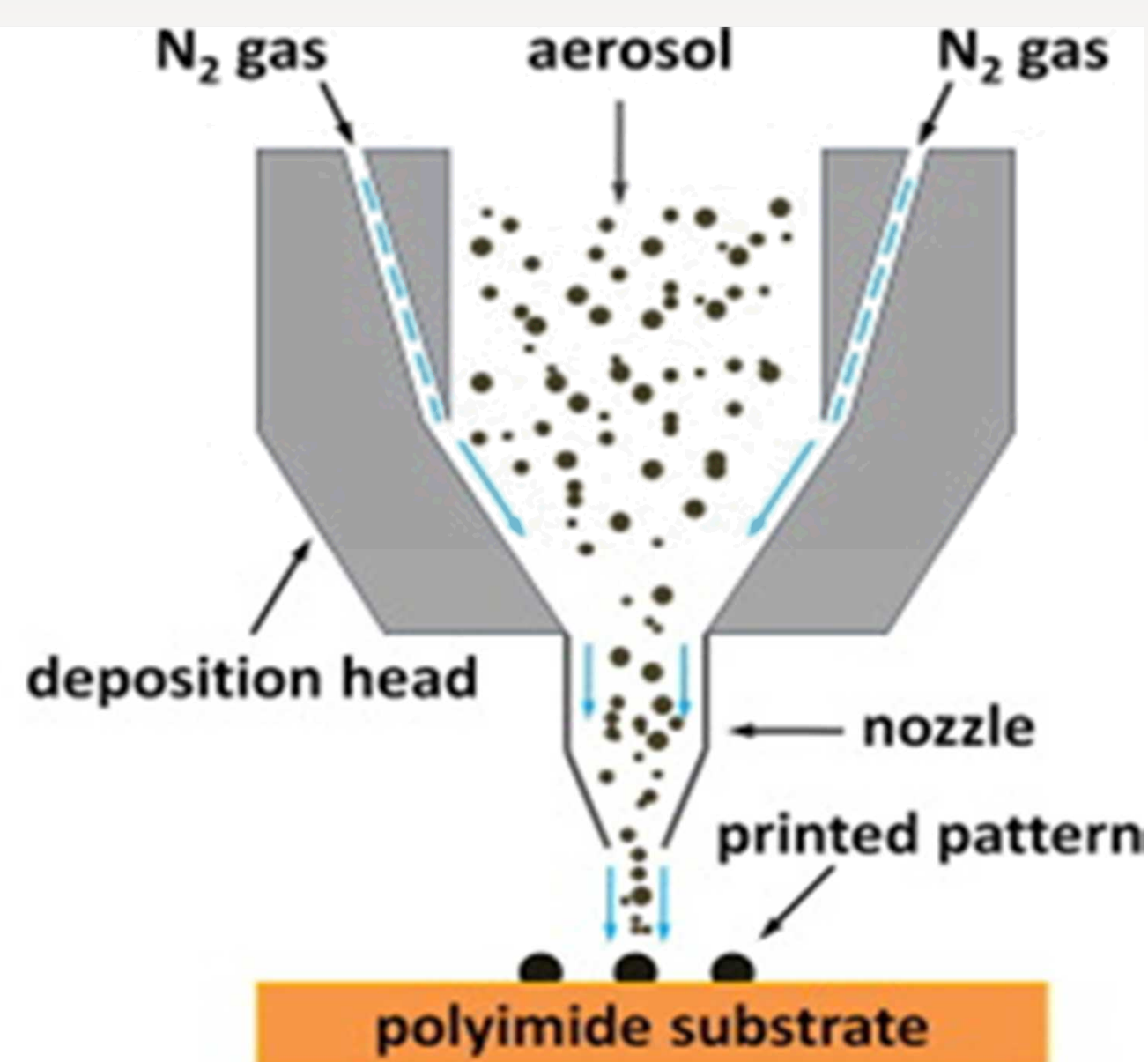


Application and Improvement with Aerosol Based Printing Technology for Electronic Applications



Direct Write Printing Applications at SNL

Why Printed Electronics?

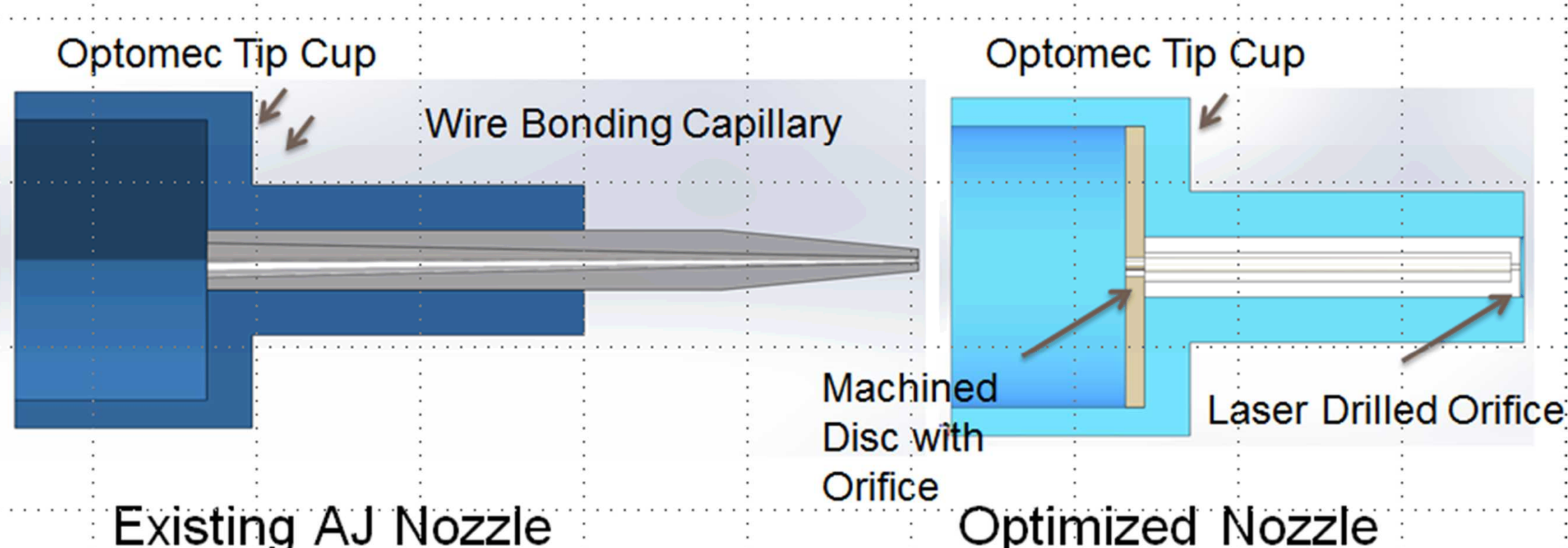


Aerosol Jet Printing for Electronics

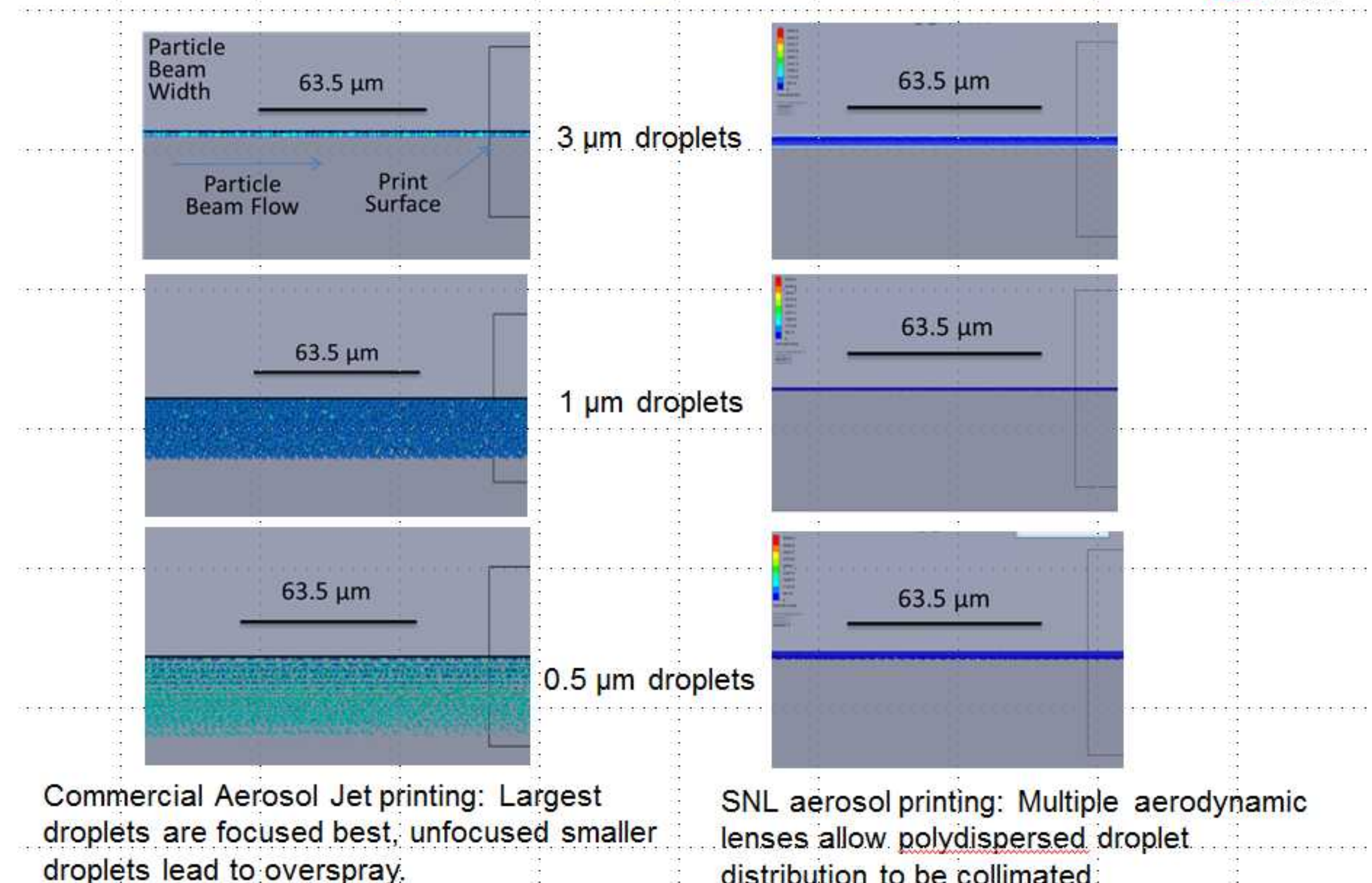
Post Process Ink Curing

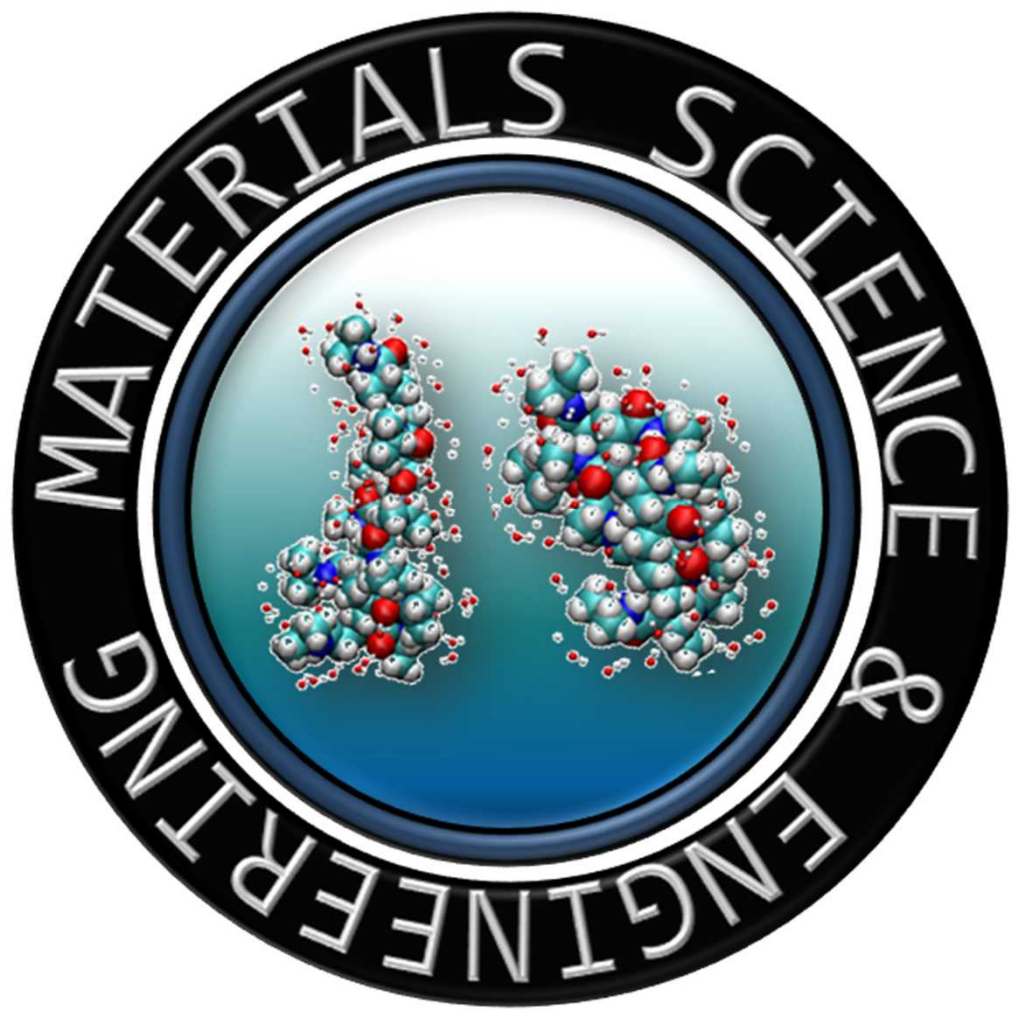
Old Nozzle vs. New Nozzle

- Commercial Nozzle Uses Wire Bonding Tip
 - Not optimized for aerodynamic focusing
- Modified Nozzle Optimized for Aerodynamic Focusing (reduce overspray)
 - Implementing and testing requires 2 parts
 - One machined orifice
 - One commercial orifice



Commercial Droplet Focusing vs. SNL Technology



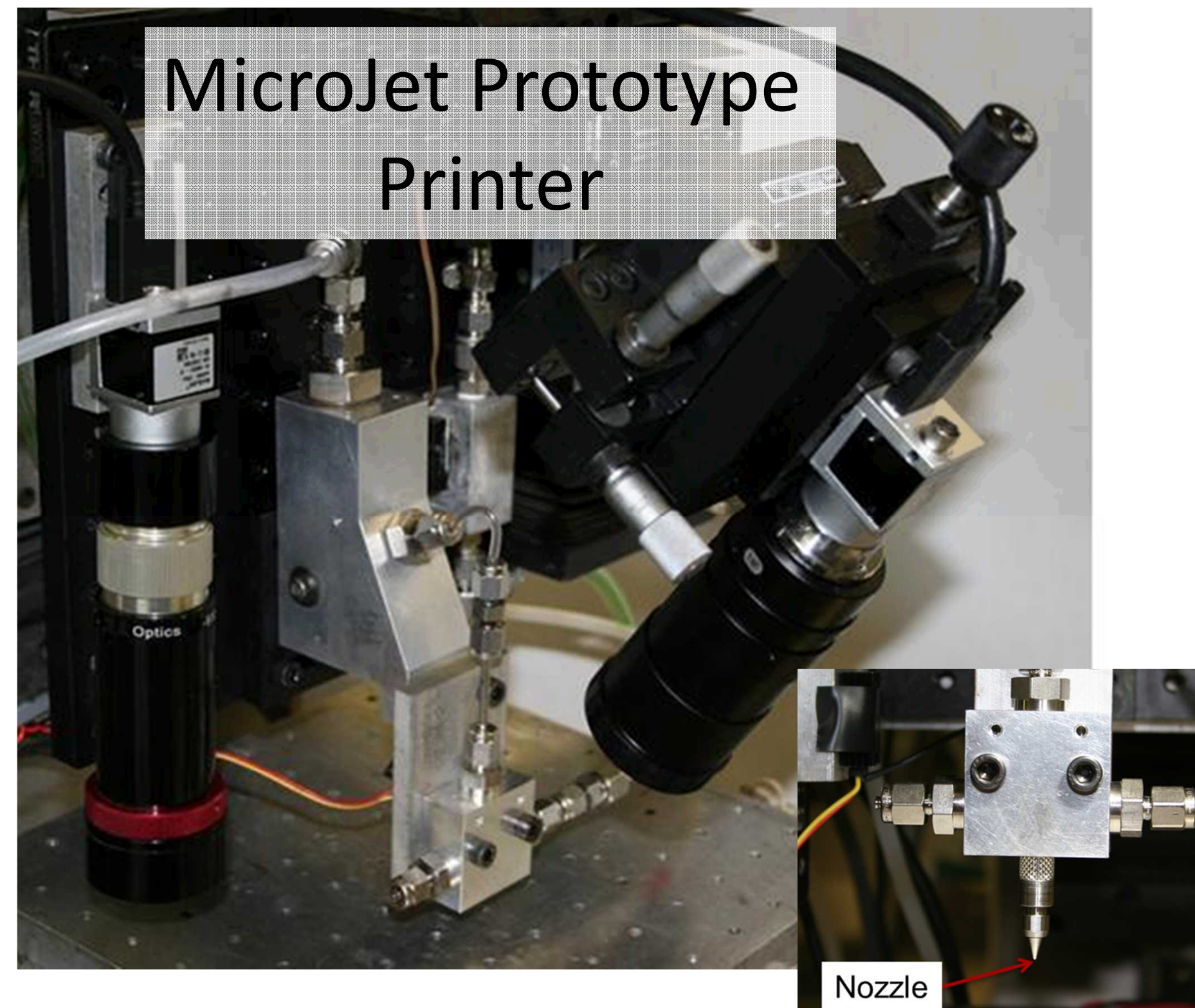


Application and Improvement with Aerosol Based Printing Technology for Electronic Applications

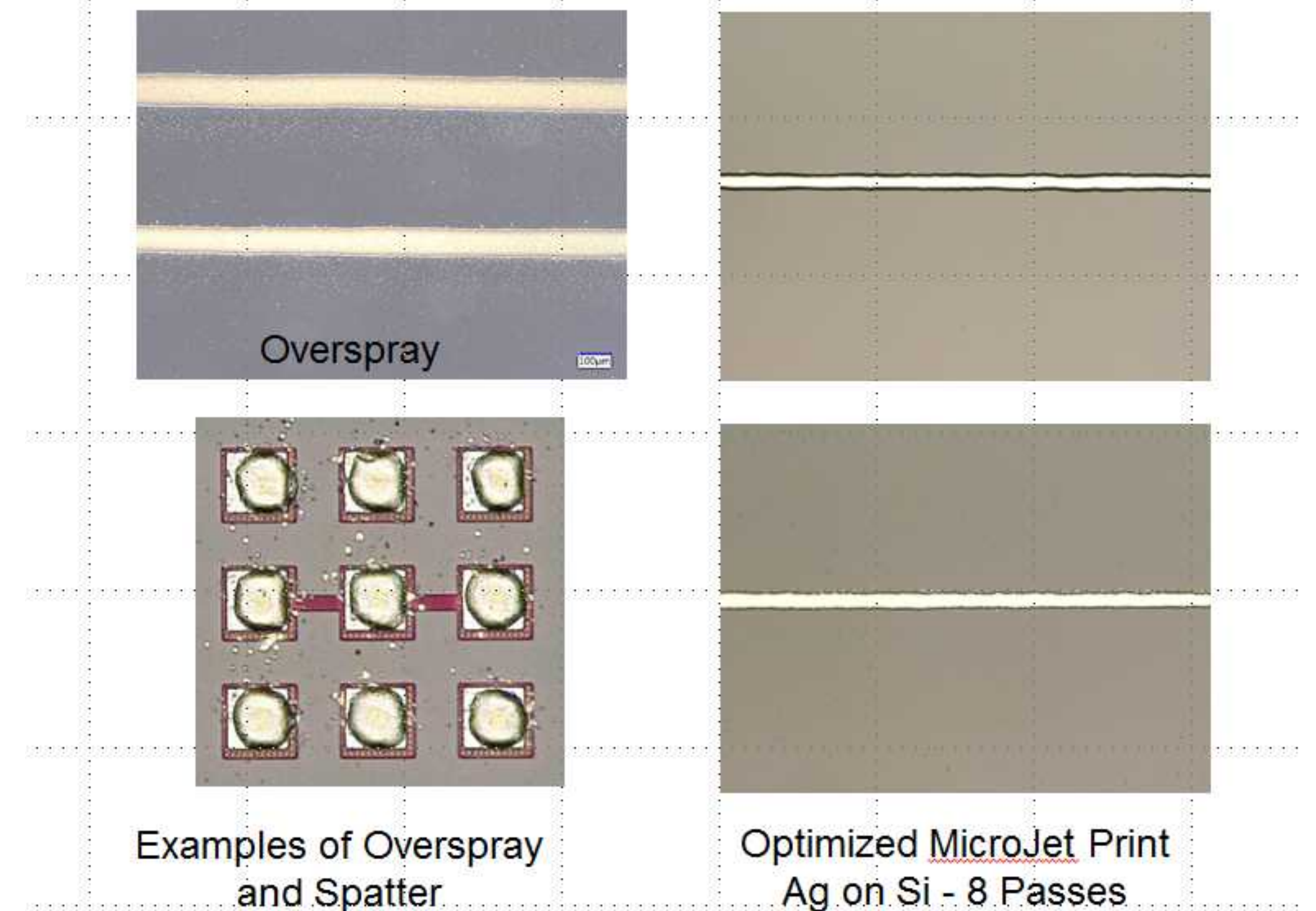


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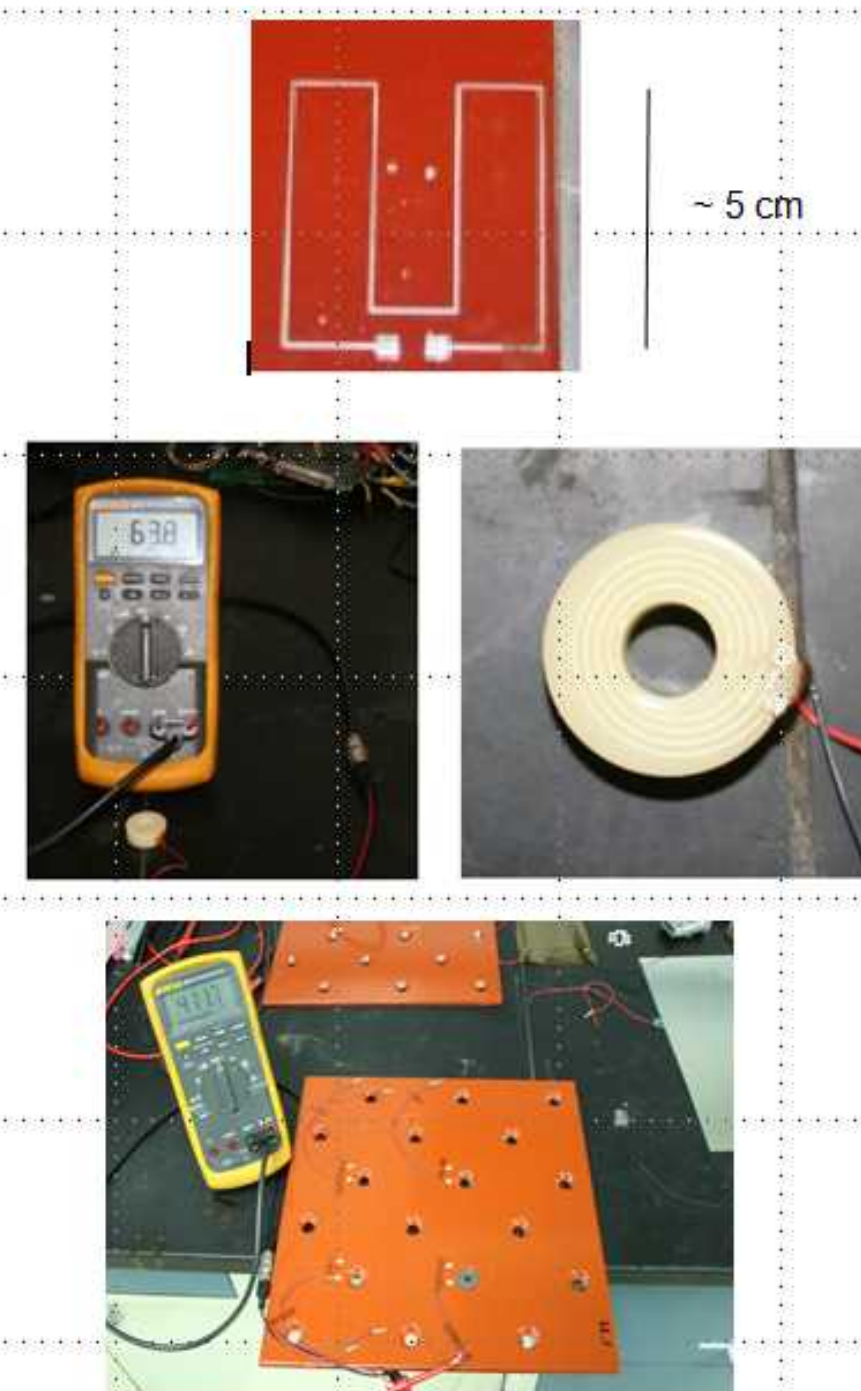


Process Modeling Drives Improvements

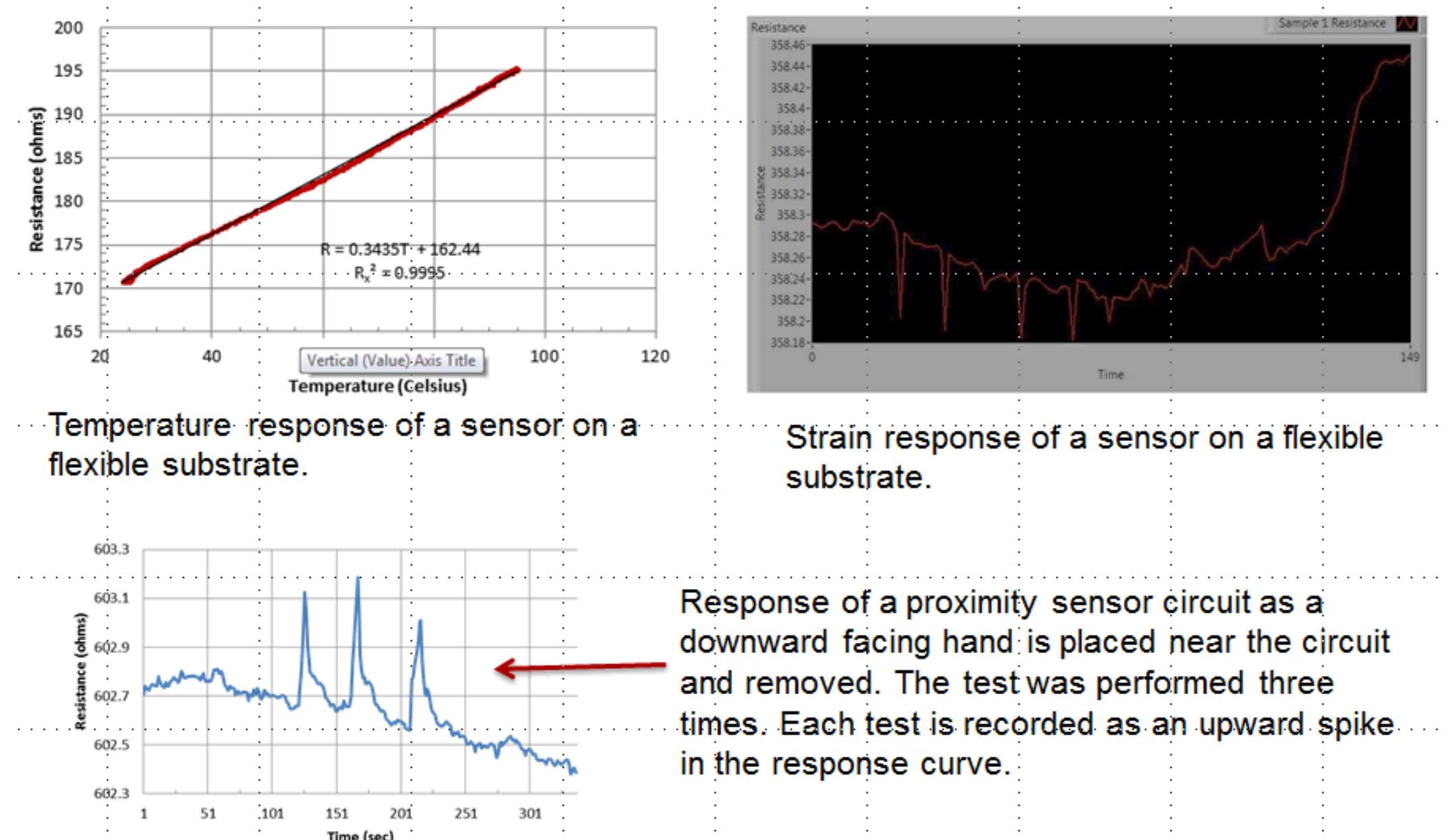


Large Area Sensors

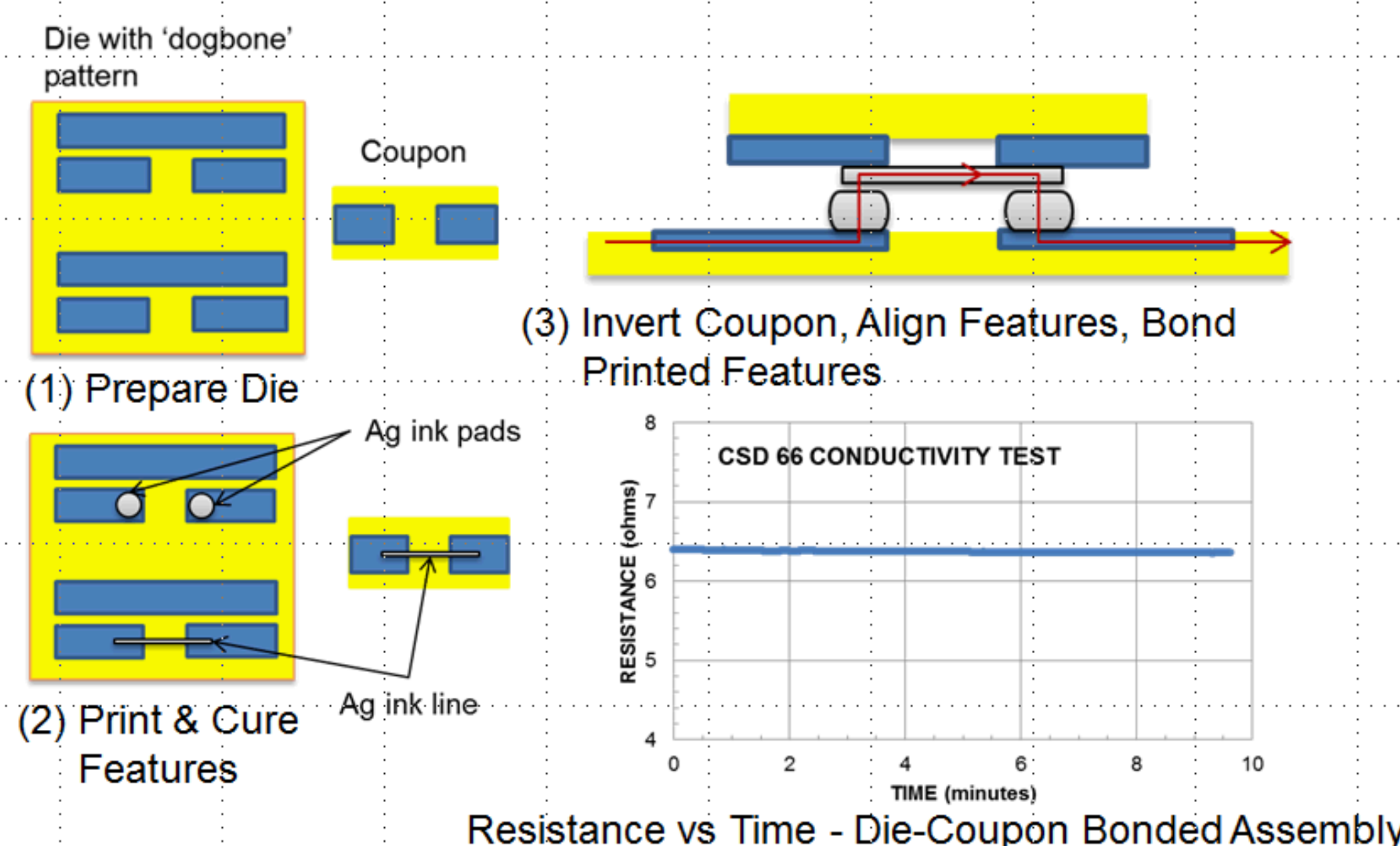
- Proof of Concept Effort
- Multi-Layered Structures Created to Isolate and Embed Sensors
 - Stainless steel substrate
 - Powder coating for 1st dielectric
 - Printed Ag traces to create sensors
 - Over-coated with 2nd dielectric to isolate and protect
- Application
 - Structural health monitoring
 - Intrusion detection



Test Results – Large Area Sensors



Reversible Interconnects



Monolithic Microjet Print Head

- Design based on cold spray technology
 - Provides tightly collimated aerosol stream
- Multiple aerodynamic lenses provide efficient collimation of polydispersed aerosols
- Monolithic design provides stable output for many hours of continuous operation
- Cost effective solution is enabling maker community adoption
- Moves technology toward cartridge based system

