

AEROSOL JET® Materials FAQs



Materials for Aerosol Jet printing

Aerosol Jet systems have the unique ability to directly print a wide range of electronic and biological materials onto almost any substrate. The Aerosol Jet deposition process supports a broad range of commercially available materials, as well as custom formulations.

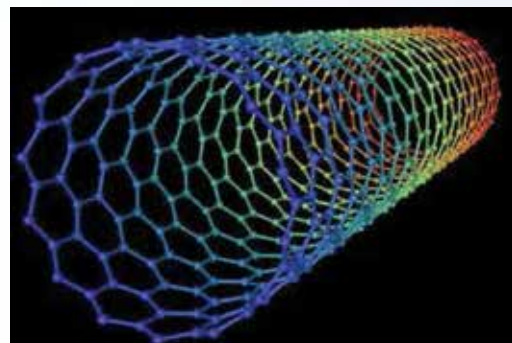
Min/Max Printable Feature Sizes for Aerosol Jet Systems

MINIMUM FEATURE SIZE IS MATERIAL DEPENDENT:

- ▶ ~10 μm features consistently printed on SiO₂
- ▶ Pitch between lines can be $\approx 20 \mu\text{m}$

MAXIMUM FEATURE SIZES ARE USER CONTROLLABLE:

- ▶ Millimeter size features using a wide nozzle print head
- ▶ With multiple passes, features sizes are limited to the size of the underlying substrate



Carbon Nanotube

TYPICAL PARTICULATE BASED INKS FOR AEROSOL JET SYSTEMS:

SOLVENTS:

- ▶ High boiling point / low vapor pressure (compare to ethylene glycol)

PARTICLES:

- ▶ Size: 300 - 500 nanometers maximum ; < 200 nanometers preferred
- ▶ Solids content: 5 - 70 wt%
- ▶ Multiple solid components, if used (e.g. silver and glass frit) should be equally dispersed throughout ink

PARTICLES:

- ▶ Viscosity: 1.0-1,000 cP at ambient temperature, or by heating the ink (ink dependent)
- ▶ Shear behavior: shear thinning or Newtonian – preferred; shear thickening -unacceptable

MATERIALS

SUPPORTED MATERIALS:

- ▶ Pure liquids or solvents
- ▶ Solutions
- ▶ Dispersions
- ▶ See next page for Aerosol Jet printed material listings

Aerosol Jet Systems Material/Substrate Matrix

METAL INKS	RESISTOR INKS	NON-METALLIC CONDUCTORS
ANP (Ag) Applied Nanotech (Ag, Cu, Ni, and Al) Clariant (Ag) Creative Materials (Ag and AgE) Dupont (Ag) Henkel (Ag) Intrinsic (Cu) Nova-Centrix (Ag and Cu) Paru (Ag) PV Nanocell (Ag and Cu) Resin Designs (AgE) UT Dots (Au, Ag, Pt) Sun Chemical (Ag) Xerox (Ag)	Acheson (carbon) Asahi (carbon) Dupont (carbon and ruthenate) Lord (carbon) Metho	Heraeus (PEDOT:PSS) NanoIntegris (SWCNTs and MWCNTs) Chasm Advanced Materials (SWCNTs and MWCNTs)
DIELECTRICS AND ADHESIVE	SEMICONDUCTORS	REACTIVE CHEMISTRIES, RESISTS, AND ETCHANTS
Aldrich (polyimide) BASF (PVP) Dupont (Teflon AF) Gersteltec (SU-8) Henkel (adhesives) Loctite (adhesives) Mantech Materials (polyimide) Microchem (SU-8) Nazdar (opaque coating fluids) Norland (UV adhesives) Summers Optical (UV adhesive) Sun Chemical (UV acrylics)	Aldrich (organic semiconductors) Alfa (organic semiconductors) Brewer Science (SWCNTs) Cheap Tubes (SWCNTs) Merck (organic semiconductors) NanoIntegris (SWCNTs) Southwest Nanotechnologies (SWCNTs)	Aldrich (general solvents, acids, and bases) Alfa (general solvents, acids, and bases) Rohm & Hass Shipley (photo and etch resists)

ABOUT OPTOMECH

Optomec® is a privately-held, rapidly growing supplier of Additive Manufacturing systems. Optomec's patented Aerosol Jet Systems for printed electronics and LENS 3D Printers for metal components are used by industry to reduce product cost and improve performance. Together, these unique printing solutions work with the broadest spectrum of functional materials, ranging from electronic inks to structural metals and even biological matter. Optomec has more than 300 marquee customers around the world, targeting production applications in the Electronics, Energy, Life Sciences and Aerospace industries. For more information about Optomec, visit <http://www.optomec.com>.