

# Adhesive and Conductive – Inkjettable nano-filled inks for use in microelectronics and microsystems technology

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## Applications

Conductive adhesives are currently / potentially used for

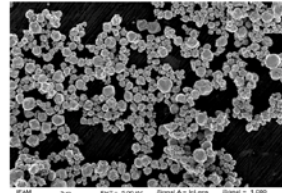
- Die attach (IC bonding in packaging)
- Electronic components mounting
- Replacement for lead-based soldering alloys

Ink jetting applications currently / potentially include

- Polymer-based electronics
- Conductive tracks printing (plasma displays, printed circuit boards)
- LCD color filters
- OLED display phosphors printing
- Solar cells front side

## Powders

**METALOR<sup>®</sup>**



### Precipitated powders

- 99,997 % Ag
- 7.0 g/cm<sup>3</sup> Tap density
- 0.55 m<sup>2</sup>/g
- 2.4 μm d<sub>50</sub>
- All particles < 4 μm

SEM picture of spherical Ag powder

All particles coated with a specific dispersant to

- ⇒ Decrease agglomeration and improve settling resistance
- ⇒ Prevent cold welding during jetting
- ⇒ Improve UV reflectivity for in-depth adhesive curing

## Ink Jetting

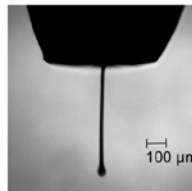
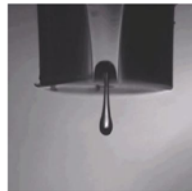
### Non-classical ink-jetting head

- Glass capillary (30 to 100 μm)
- Activated by a tubular piezo actuator
- 30 - 500 pL dispensing (± 1%)
- Up to 2 kHz dispensing frequency (square wave signal)
- Special nozzle design accommodating inks up to 200 mPas

Patent DE 10153708

### System characteristics

- Autodrop MD-P-801 positioning system (1 μm precision)
- Mobile table
- Up to 8 dispensing heads
- Stroboscopic in-line video monitoring



Stroboscopic control image of ink jet process

## Resin



2-step curing system: UV + THERMAL

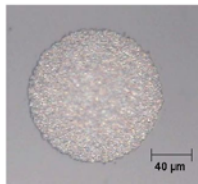
### Ink characteristics

- Acrylate-epoxy matrix
- Radical mechanism for UV curing
- Tunable bond strength by initial epoxy group concentration
- Low base viscosity (< 3 mPas), newtonian behavior
- 70 wt% Ag loading (ca.. 20 vol%)

### Process flow

- Ink jet into final form
- Pre-cure using UV under inert atmosphere
- Store < 4°C for processing at a later stage (optional)
- Components assembly
- Final thermal curing

## Printing Results



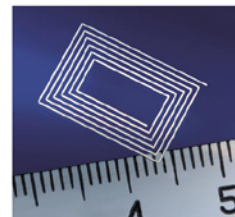
500 pL printed dot exhibiting 130 μm diameter and 30 μm thickness

- 75 μm nozzle diameter
- 500 pL droplet size (dependent on ink viscosity)

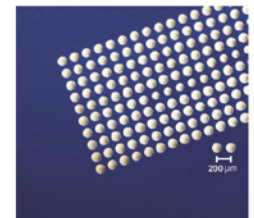
### yield

- ⇒ 130 μm diameter dot
- ⇒ 30 μm thick fully UV-cured
- ⇒ 10<sup>-4</sup> Ωcm specific resistance
- ⇒ 10 - 15 N bond strength with SMD resistors (case size 1206) on copper

- Tests underway with 50 μm nozzle
- Expected dot diameter: 80 μm



Conductive track pattern ink jet printed using the developed conductive adhesive



Array of ink jetted conductive adhesive pitch size 200 μm