Aurel-ENEA Ink-jet printing equipment

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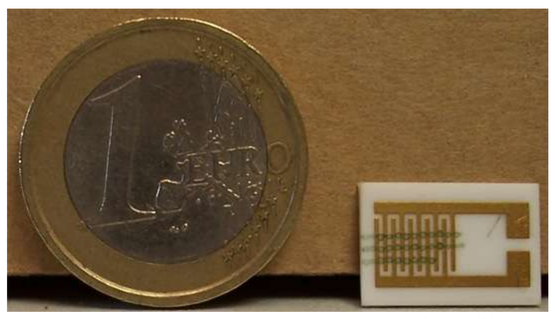
At ENEA Research Center in Portici an Ink-Jet equipment for functional materials deposition was developed and installed.
Ink jet printing is an interesting and versatile technology; it allows functional materials deposition on different substrates and following variable geometry. It is low cost and does not need temperature or vacuum. Furthermore, does not require any contact between deposition system and substrate.
In Drop on Demand (DoD) systems, drops can be released by ink jet microhead as consequence of piezoelectric actuator activated by an electric impulse. Impulse intensity and duration have to be optimized for each ink to obtain stable drops with volume in the order of 10 pL. To obtain lines and surfaces, the right overlap rate among emitted drops have to be found, so other parameters to be optimized are ink emission frequency and relative speed between printing head and substrate.
The equipment hosts maximum four piezoelectric single nozzle printing heads, with a *roll to roll* system and a post printing section for UV-IR curing. Automatic and manual functions allow functional materials deposition on substrates with maximum dimension 200x200mm. Substrate can be in reel format, with maximum width 250mm, or single sheet.
Printing head moves respect the substrate. The diameter of dry drop deposited on substrate is in the order of 100µm. Continuous lines can be obtained by overlap of drops deposited on demand with opportune frequency. Thanks to extreme versatility, the equipment can be used both for preliminary manual tests and for automatic operations able to generate complicated geometries and multilayer structures.

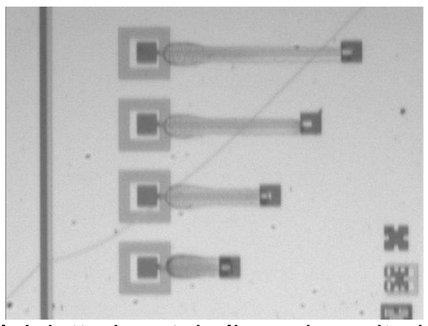
Portici Research Center:
Ink Jet printing equipment for Functional materials deposition and curing on flexible substrates or sheets:1)unwinder; 2) printing unit; 3) UV-IR post printing curing unit; 4) winder

The equipment was developed in an **ENEA** and **Aurel Automation** collaboration and can be used in a lot of applications, for example:
- Display and electroluminescent devices
- RFID tags
- TFT
- Electronic devices
- Conductive paths
- "All printed" electronic circuits
- Lubrication of small bearings
- Printing of inks with nano-fillers (Ag, Au, ITO, TiO2, etc.) and conductive adhesives
- Diagnostic and sensitive devices
- Dispensing of waxes and hot melt materials (printing heads upgrade is necessary)
- Polymer research
- Assembly of louspeakers / micro bonding
- Mounting of microlenses and optical fibres
- Assembly of glass fiber connectors
- Printing of DNA, proteins, enzymes and cells.

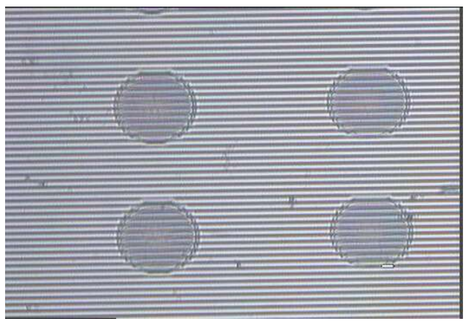
Examples of devices produced at ENEA C.R. Portici depositing functional materials by ink-jet:

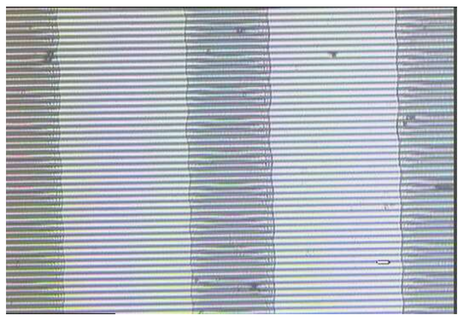


Ammonia sensor based on polyaniline (PANI) lines

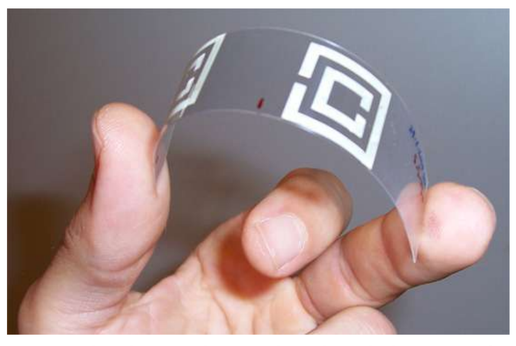


Ink jetted protein lines deposited on optical fibers for biosensor production

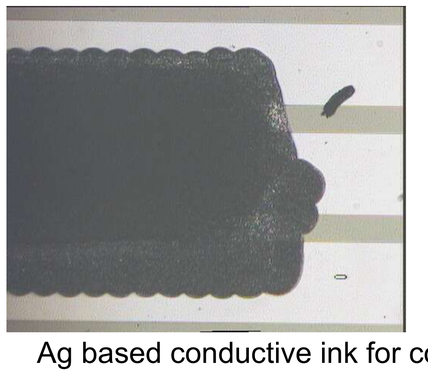


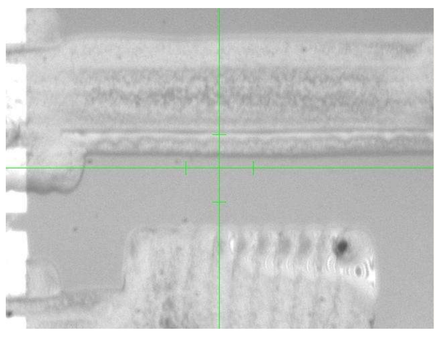


Ink jet deposited drops (left) and lines (right) on interdigitated contacts for capacitors production

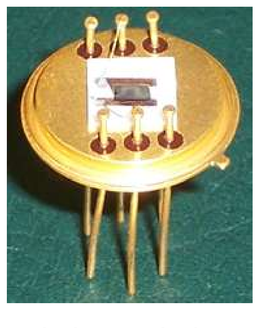


Ag based conductive ink on polymeric film for metamaterials production

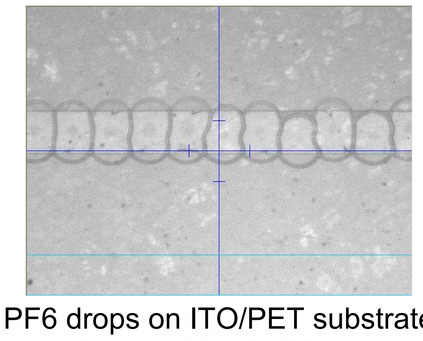




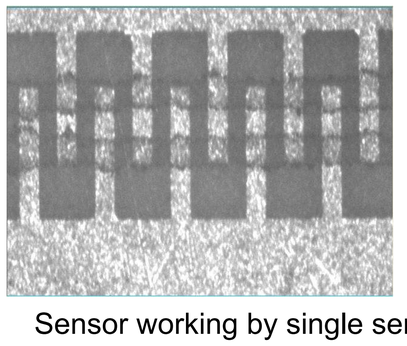
Ag based conductive ink for contacting of chromium structures on SiO_2

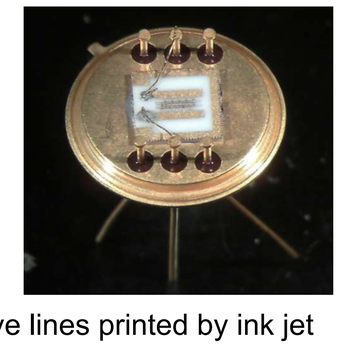


Sensor completely made by ink jet printing technique



PF6 drops on ITO/PET substrate "piranha" treated for OLED production (see more on ENEA poster 6-06-PO)





Sensor working by single sensitive lines printed by ink jet