Chemistry | Technology Offer

Highly conductive pastes for printable electronic applications and devices

Field of application

The innovative and versatile formulation platform provides highly conductive, printable pastes or inks free of polymeric or non-volatile organic additives/stabilizers. Such pastes may be used for all kind of printable electronic applications, especially for front side metallization of solar cells (inorganic material system) or even OLEDs (organic material system).
The market for printable electronics is rapidly increasing thanks to fast and inexpensive production processes. Our new formulation concept delivers tailor-made products for such innovative fabrication technologies.

State of the art

A large variety of printing technologies such as screen printing, gravure printing, dispensing or ink jet printing exist for the production of printable electronic devices. The processed pastes (ink formulations) have to meet several very different requirements regarding stability and flow depending on the respective printing or coating technique and desired product specifications. Accordingly, rheologi-cal additives/stabilizers are used in such formulations which, unfortunately, can never be removed completely during subsequent processing steps, e.g. annealing or sintering/firing. As a result these residues often detriment-ally affect product properties of the pastes, in particular their conductivity and related electronic properties. Re-moval of processing equipment from unwanted residues is another important issue.

Innovation

At the Karlsruhe Institute of Technology (KIT), a new platform concept for the formulation of highly conductive, printable pastes has been developed. Corresponding pastes are free of polymeric or other non-volatile stabilizers and rheology control agents. Nevertheless, rheological properties like low-shear viscosity and yield stress can be adjusted in a wide range. Thus sedimentation /aggregation is prohibited and long-term stability can be guaranteed even for suspensions of high density particles (e.g. Ag, Ni). Also full control of the application behavior in many different printing/coating operations is furnished.
The innovative process uses the so-called capillary suspension concept: Adding a small amount of a secondary, immiscible fluid to a suspension of the conductive particulate solid in a liquid primary phase. This leads to a capillary force controlled microstructure based on liquid bridges between the conductive particles. In addition, this capillary suspension concept works with different solvent combinations and with a wide variety of particle sizes and shapes. Even more important, the secondary fluid crucial for stability and processing of the pastes is completely evaporated during the subsequent drying and sintering/firing steps.

Your benefits at a glance

- ✓ Printable Pastes with
  - high conductivity (double compared to commercial silver pastes)
  - no stabilizers or rheology control agents, i.e. low cost and high purity
  - long-term stability
  - high shape accuracy
  - narrow line widths, high aspect ratios
- ✓ Rheological properties can be tuned in a wide range according to application demands
- ✓ Pastes made of inorganic or even organic conductive particles
- ✓ Compatible with established printing and coating equipment

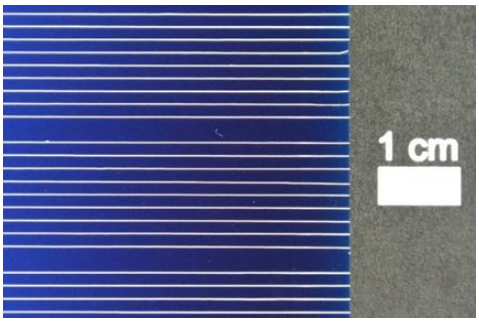

Figure 1: Deposition of fine silver electrodes on a silicon wafer using a dispenser system with 50 µm nozzle diameter (Fraunhofer ISE, Freiburg).

Technology transfer

Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology and assists companies in obtaining licenses.

Patent portfolio

A European patent for this invention was filed in 2016.

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