

New Dimensions in Printed Electronics

DUPONT MICROCIRCUIT MATERIALS



The miracles of science™



Introduction

The DuPont commitment as a major supplier to the Printed Electronics industry has been ongoing for more than 40 years, starting with the development of a stable, high performance resistor material printed on alumina which made possible a new generation of computers. Since that time, DuPont has become a global leader in low temperature curing inks for flexible substrates – a position it owes to its broad experience in materials science, chemistry, fine powder technology, organic materials and solvents. As a science-based company, the broad technology base and global presence enable DuPont to develop innovative products aimed specifically at meeting today's electronic requirements, often outside its traditional field of operations.

Such developments need to be user-friendly, with simple manufacturing steps and high yields, while remaining environmentally responsible. At DuPont, we are supported by a highly skilled R&D and technical service group and by a specialised sales and marketing force, intent on pursuing new opportunities and providing novel solutions to the multitude of modern electronic applications.

RFID Antennae

Hundreds of millions of tags and labels based on RFID technology are currently used in applications ranging from transport ticketing and secure access control solutions to electronic passports and ID documents, library management, animal tracking and sports timing systems. Emerging applications, such as real-time tracking of pallets, cases and even single items along the supply chain, will require hundreds of billions of these RFID tags and labels and are driving the increasing demand for low cost tags which will enable high volume deployment of RFID technology.

A critical item of these RFID transponders is the passive antenna which has to meet three criteria:

- Reliable enhanced electronic performance (impedance);
- Easy to produce in high volume at low cost; and
- Easy assembly of the chip onto the antenna.

Material solutions from DuPont Microcircuit Materials (MCM) consist of low temperature curing silver and dielectric ink compositions that have already been used to produce tens of millions of antennae. The applications include transportation tickets, e-passports, contact-less smart cards and other types of RFID tags and labels operating at 13.56 MHz and 915 MHz (UHF) frequencies.

Inks offered by DuPont MCM for the fabrication of RFID antennae can be printed and cured on different types of films and substrates, including paper, polyester, polycarbonate, FR4, PVC and ABS. Contact-less cards can be manufactured with

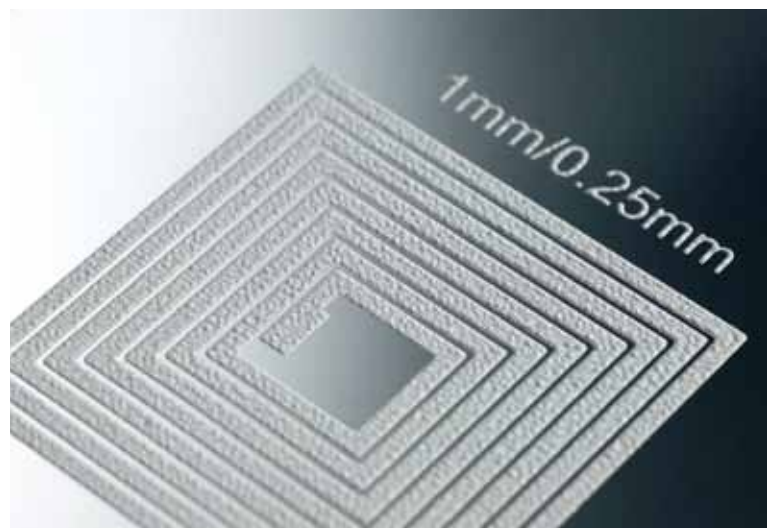


Printed RFID antennae – an additive process

a simple and highly automated, reel-to-reel process at lower costs compared to cards made with etched and/or plated antennae. Significantly, the process is additive thus eliminating waste associated with etched alternatives.

The latest generation silver ink developments from DuPont Microcircuit Materials (MCM) allow even greater economy of use by achieving extremely high conductivities at relatively low print thickness.

Printed RFID antenna





Biosensor inks

Biomedical and Healthcare

The biomedical and healthcare industries have benefited from the advancement of materials for Printed Electronics. DuPont MCM has a full range of functional inks for use in the fabrication of biosensors. These biosensors are typically used in medical monitoring, diagnostics and drug delivery and are fabricated on flexible or ceramic substrates using screen or other high speed printing techniques.

Products

- Electrically conductive compositions including silver, gold, and carbon for lines and contact pads
- Silver / Silver Chloride compositions used as electrodes for amperometric sensors, potentiometric sensors, iontophoretic drug delivery devices and medical electrodes
- Precious metal-based compositions for working electrodes in amperometric sensors used in analyte detection

Typical Applications

- Enzyme-based amperometric biosensors for metabolic analyte testing (e.g. blood glucose, cholesterol, lactate)
- Potentiometric sensors for selective ion detection of body electrolytes
- Iontophoretic devices for drug delivery and cosmetic patches
- Trace / heavy metal and food freshness sensors.
- Blood gas sensors
- Vital signs monitoring

As the number of applications in this important area increases, the DuPont family of customizable products can deliver flexibility, high density and rapid prototyping using cost-effective, well established manufacturing routes.



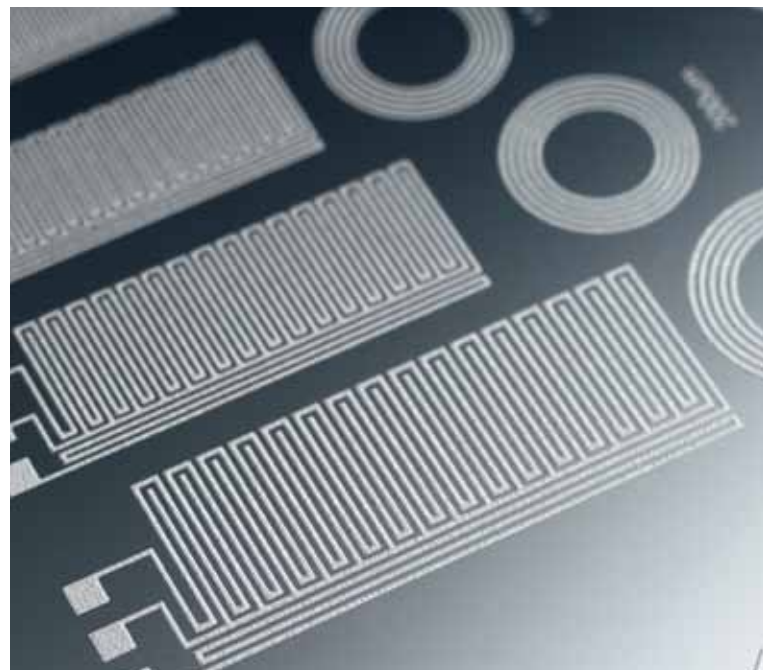
Biosensor courtesy of Oncoprobe Ltd

Interconnects

DuPont MCM originally developed a family of carbon, silver and dielectric inks for use in membrane touch switch circuits. These have evolved into materials for all types of lines, interconnects, pads and switches on various flexible substrates.

By varying the binder resin chemistry we can alter the adhesion, flex and thermal properties. By adjusting the active component we provide inks for all different applications depending on resolution and resistivity requirements. Most of these materials are screen printable and new custom developments for flexo / gravure are currently underway.

Fine line Ag circuitry





Backlit EL keypad

Electroluminescent Lighting

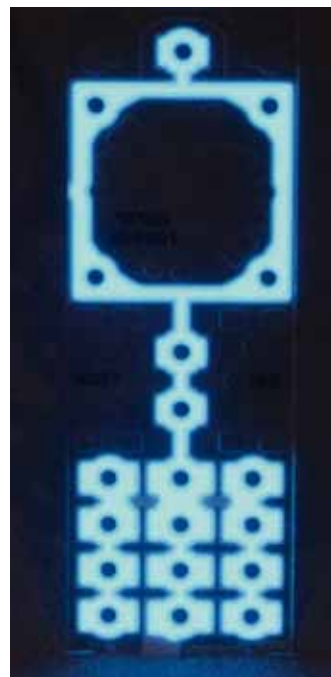
DuPont first introduced a range of inorganic electroluminescent (EL) compositions back in the 1980s but widespread adoption was slow. The EL market, however, was re-energised in the mid 90s and commercial success was primarily achieved through innovations in electronics, phosphor encapsulation and the introduction of DuPont™ Luxprint® electroluminescent materials technology.

DuPont™ Luxprint® compositions have demonstrated versatility and robustness with more than 12 years reliable performance in various markets and applications. The Luxprint® family consists of a special series of conducting, insulating and phosphor inks suitable for manufacturing printed lamps, enabling companies skilled in screen-printing of electronic circuitry to easily manufacture flexible EL lamps.

New demands on lighting along with technology advances have therefore provided the opportunity for a fundamental shift in the role of electroluminescent lighting. Many new markets exist today, thanks to the creativity of companies keen to expand their products in new markets and applications.

For example, the benefits of EL have extended into the following areas:

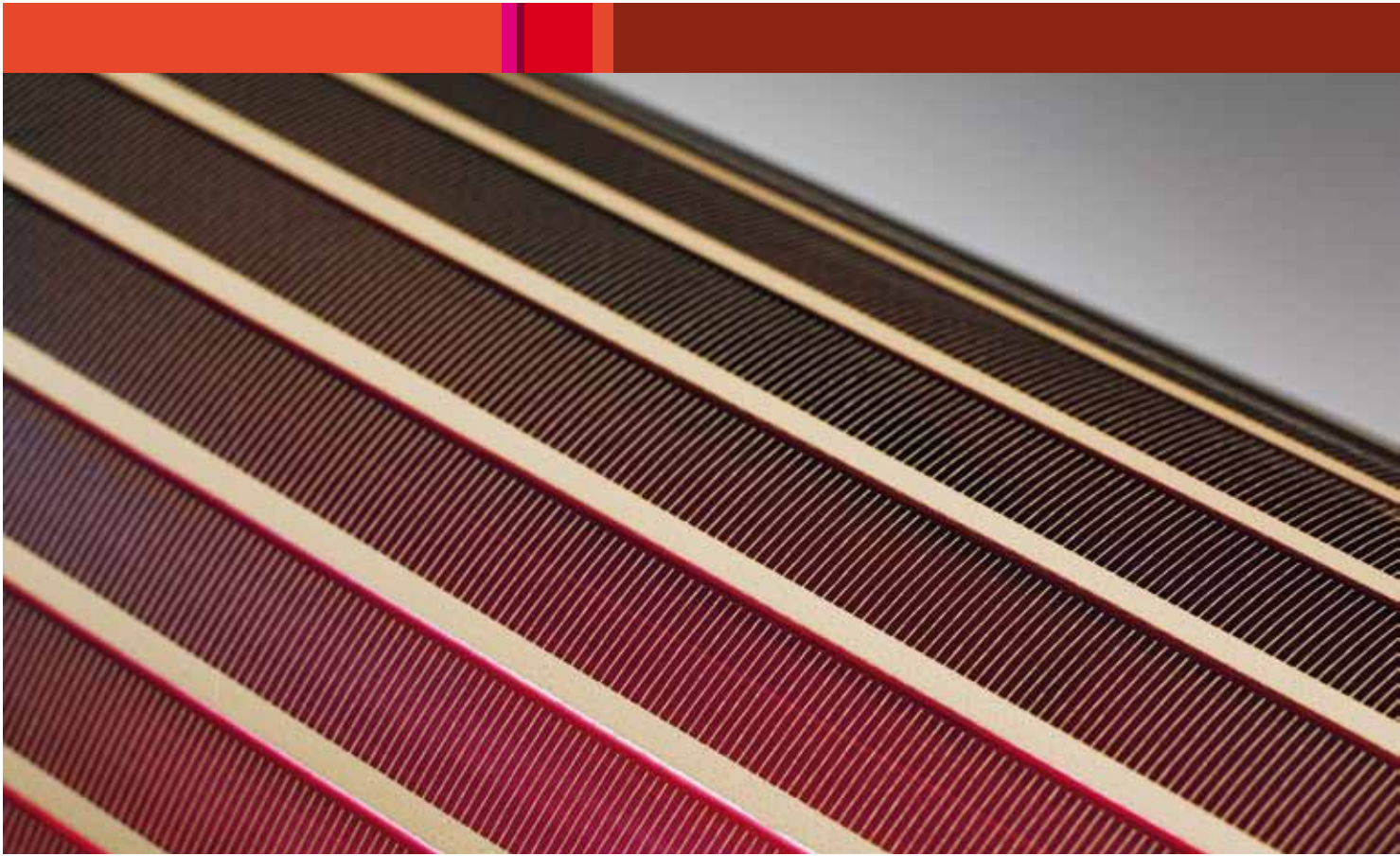
- Signage – providing large area panels with “intelligent” sequenced lighting especially suitable for advertising.
- Automotive – applications include dashboard and mood lighting, kick plates and several other novel applications.
- Backlighting of handheld portable instruments – include mobile phones with backlighting of the display and keyboard.
- Decorative lighting – used in bars, nightclubs and cinemas.
- Street signage – ideal for busy street intersections.



Remote keypad courtesy of GSI Technologies, LLC

Flexible EL strips





Flexible organic PV – Courtesy of RISØ

Photovoltaic Applications

For more than 25 years, DuPont has been a leading supplier to the Photovoltaic (PV) industry. DuPont™ Solamet® photovoltaic metallizations have helped improve cell efficiencies allowing strong growth in a world looking for more sustainable energy solutions.

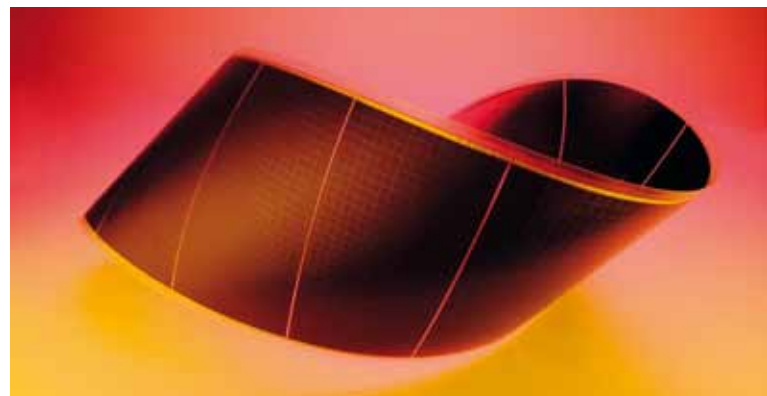
DuPont offers a comprehensive range of Solamet® compositions for traditional crystalline Silicon cells. DuPont has also introduced a range of Solamet® metallizations for Thin Film PV applications which find potential use in various innovative technologies such as Cl(G)S, CdTe, DSSC, OPV and a-Si cell structures, enabling more cost effective manufacturing of solar cells with improved efficiency and yield.

Applications

- Front side grid and bus bars
- Back side contacts
- Solder pads for various interconnection technologies

Key Paste Properties

- High conductivity and low contact resistance
- Compatibility with TCO's including ITO and ZnO
- Fine line resolution enabling flexible and durable cells
- Dry at low temperature, typically 130 °C to 200 °C
- Designed for mass screen printing production including reel to reel and rotary screen
- Customizable technology platform for other thin film cell structures



Courtesy of Ascent Solar

Other Printed Electronics Applications

The broad range of DuPont MCM customizable formulations are suitable for numerous Printed Electronic applications. These include silver, carbon, dielectric and other specialist metallurgy inks designed for the below applications:

- Printed batteries
- Printed sensors
- Smart packaging
- Flexible displays
- OLEDs
- Self regulating flexible heaters
- Smart textiles
- Touch screens

Flexographic Imaging and Substrate Solutions for Printed Electronics

DuPont Packaging Graphics uses science to create innovative colour and printing technologies.

Cyre® FAST is a thermal plate making system including flexographic photopolymer plates, plate making equipment and developer roll.

DuPont Teijin Films is a joint venture between DuPont and Teijin and is the world's largest producer of polyester films.

Teonex® PEN film and Mylar® and Melinex® PET films are broadly used in printed electronics applications.

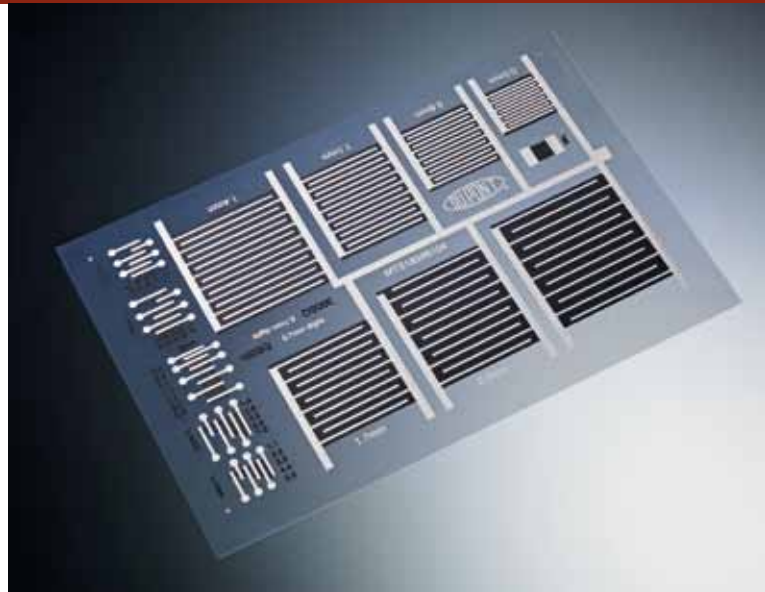
Innovating for the Future

Building on over 40 years of low temperature curing ink expertise, DuPont is exploring the boundaries of Printed Electronics materials and processing. Our global R&D labs are producing highly advanced, specialty materials for use in the next generation of inks. Our polymer scientists are developing sophisticated binder systems for greater adhesion, flexibility and conductivity. To compliment our screen formulations, we are introducing conductive flexographic inks and ink-jet formulations to meet the future requirements of our customers.

The Science of Listening

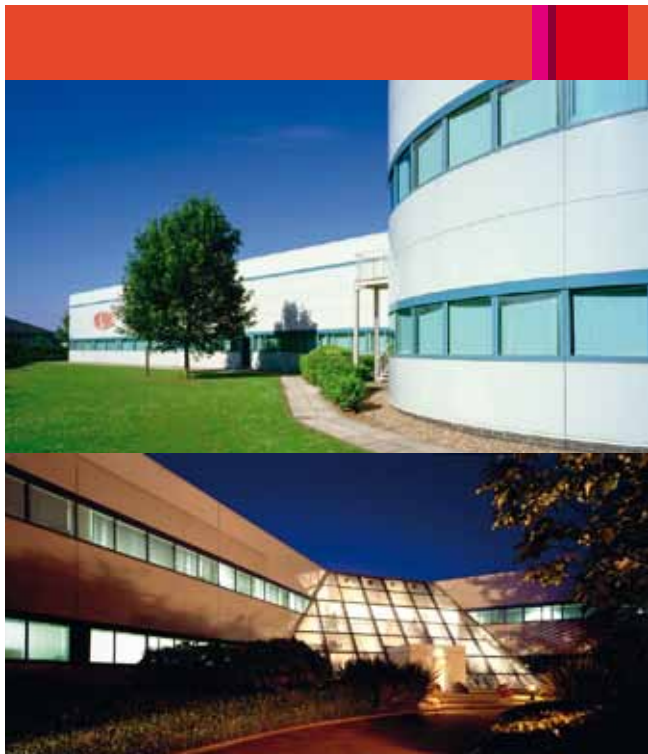
Our research and development activities are geared towards finding sustainable solutions that meet the needs of our customers and end-users. This means the most important skill for both our scientists and our marketing teams is listening, listening to the challenges our customers face and to the trends which are shaping consumer demands.

So whatever challenge you face in Printed Electronics – please talk to DuPont first. You can find your local contact on the back cover.



Self regulating heater on flexible substrate





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