PRINTING ELECTRONICS REPORT
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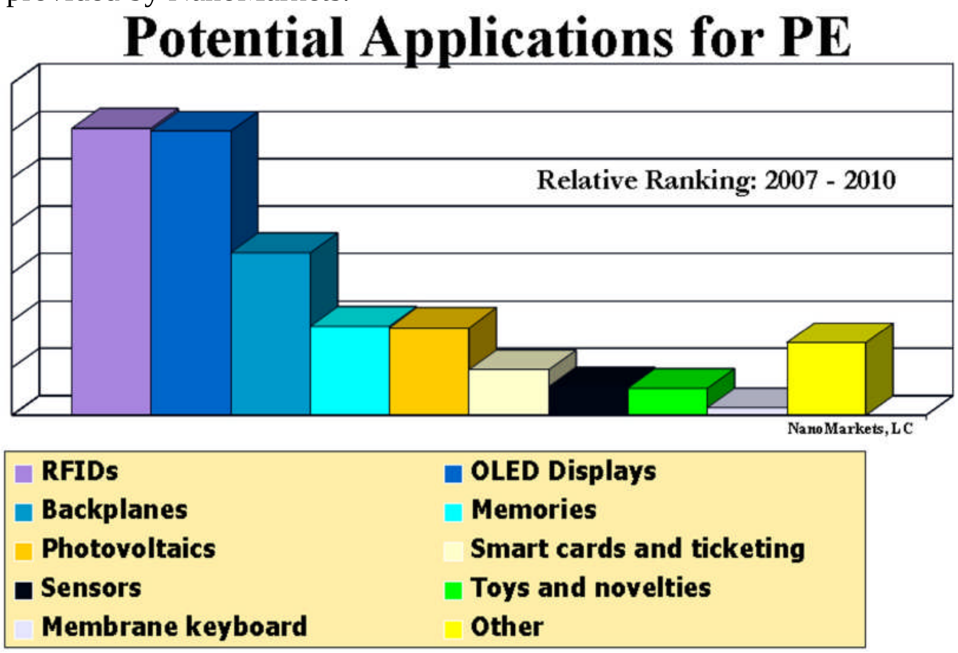
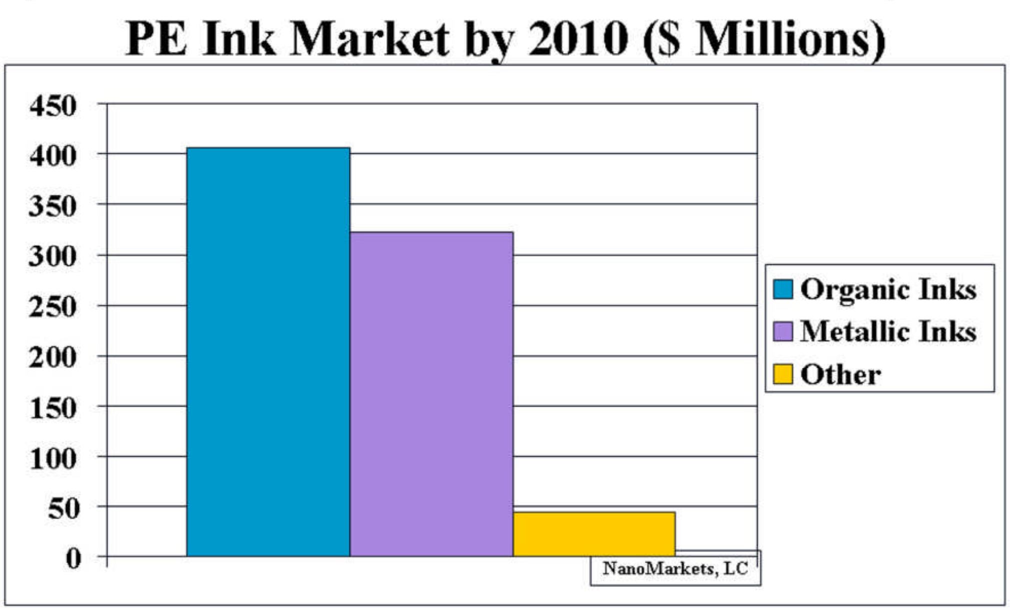
ET TRENDS

BUSINESS & MARKET NEWS

PE MARKETS

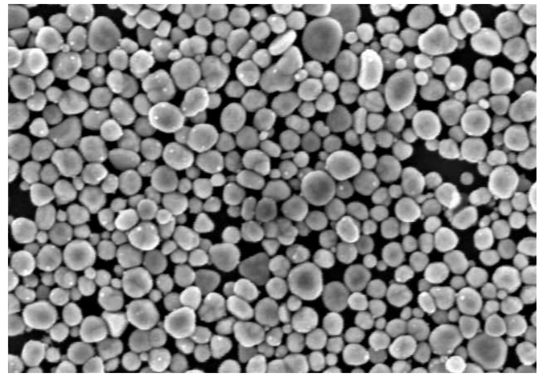
These charts provided by NanoMarkets.





It's not obvious to me that the almost-emerging PE industry understands itself. There's too much combining of old and new technologies, especially concerning inks. Too many people think that conductive inks will be based on silver forever, and that we need to just find the right kind of nano-silver. I can see no reason why going to smaller particles will solve any of the problems.

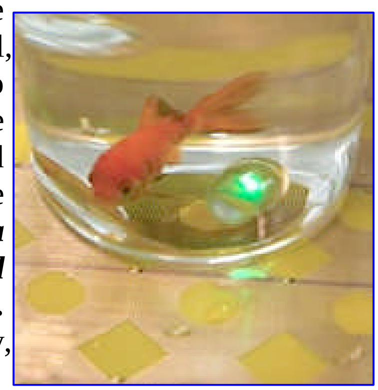
Silver is plagued with intrinsic problem and needs to be replaced, but there seems to be little, if any, effort to swap the over-active, increasingly expensive metal, for an engineered material. We've also been hearing for years, that carbon nanotubes (CNTs), added to silver, will fix everything, but that theory is also weak and results have been unimpressive. That said, PE represents a large potential, but we need a clearer plan, and a good roadmap, that may be coming.



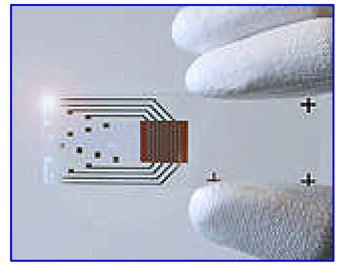
Silver Forever? - The market for silver conductive inks is predicted to reach $1.2-billion by 2014, compared with $176-million currently, according to a report from NanoMarkets. Nanoparticulate silver inks will likely lower the costs of printed electronics by reducing the need for high-temperature processing and enabling less material to be used; because lower temperatures are needed to cure nano-inks, they are also more suitable for use on flexible substrates that typically use thermally sensitive plastics. According to the report, the market for silver nano-inks is expected to reach $844-million by 2014. ***[This recent market report helps make my point. No one is looking beyond silver that has always been a limiting factor for PTF and printed electronics. Silver migration is real, and especially get's worse at higher-density (closer conductor spacing). There's a large opportunity for a new material. Many of the silver-replacement ideas, from several decades ago, were sound, but never completed. They include plated copper, solder-coated base metals, and sintering alloys].***

TECHNOLOGY

Printed Electronics for Wireless Power Linking - The University of Tokyo has demonstrated a 1-mm sheet of "electronic plastic" that can deliver power to nearby devices. One could cover a desk with the material and power computers, for example, just by setting them on top. The key technology is Printed Electronics in the form of organic transistors that are printed right onto the material. Localized MEMS switches control the flow of power while copper transmits the current inductively. The powered up sheet can power devices, such as LEDs that are built with a matching receiver coil. When these are placed within 2.5-cm of the sheet, the nearest MEMS switch turns on, feeding power to the closest sender coil, which powers the device coupling has 81.4% efficiency compared to 93% for a wired grid network. All 4-layers of plastic power sheet are produced by printing. The coils are screen printing while the switch and transistor layers use an ink-jet printer with special electronic inks. The product is thin, lightweight and mechanically flexible. ***[While the idea of inductive coil coupling is as old as the transforming, and is used for RFID, the Printed Electronics component is much more novel].*** The photo shows an LED being powered in a fish bowl and presumably, the fish is unscathed. What about electric eels?

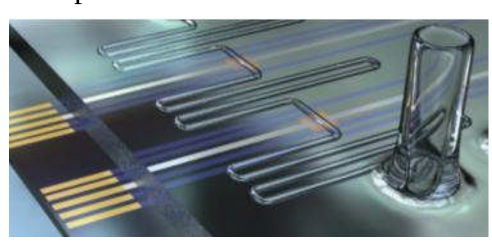


Where is ST-Micro Headed? - Now that ST is talking about *plastic electronics*, without explaining what they mean, I did some searching of the website for hints. They are working on *Post Silicon Technology* (PST). Whenever a silicon-centric company is working on non-silicon, that's an open-minded attitude. ST has been working with Obducat to assess Nano Imprint Lithography (NIL) technology as a potential scalable patterning method for all-organic and hybrid electronic devices with feature size in the range of 50nm. All-Organic Electronics teams in Catania and Portici (Naples) have been evaluating NIL as a step in the development of a completely new technology platform for All-Organic and Hybrid electronics that could be manufactured at ultra low-cost by means of non-photolithographic processes. The achievement of device structures with nanoscale resolution via simultaneous thermal and UV-based Nano Imprint Lithography on large areas, makes the Obducat system attractive in patterning a wide range of organic materials.



Printed Bio-detectors - BIOIDENT Technologies is a developer of printed optoelectronics for life sciences and now claims the industry's first complete, functional lab on a chip, the PhotonicFlow System. This system's first application involves a multi-well chip, a handheld device controller, and readout software. The PhotonicFlow System is based on BIOIDENT's PhotonicLab Platform that combines printed semiconductors with various lab-on-chip technologies. The technology is well suited for disposable lab-on-a-chip devices for cost-effective mobile diagnostics and analysis. The PhotonicFlow System is an expansion of the nanotiter plate prototype, a 1"x3" multiwell chip with a fully integrated photodetector array based on printed semiconductor technology; there is a dedicated pixel under each well of the chip that converts light into electrical signals to enable real-time analysis of multiple agents. The PhotonicFlow System includes a handheld device controller for electronic readout of the signals from the photodetector and the readout software for analytics and calibration. This eliminates the need for large, expensive, external readout systems and opens up new opportunities for applications in medical in-vitro diagnostics, chemical and biological threat detection, and water testing. The PhotonicLab Platform uses printed semiconductor-based technology to print light detection and electronics capabilities directly onto any surface, including glass and plastic materials, enabling on-chip analysis and diagnostics. In addition, existing assays and reagents are used with established testing protocols to deliver real-time and in-situ, multi-parameter detection capabilities for all categories of chemical and biological analytes. BIOIDENT's printing process can also be used to create a wide variety of existing in-vitro diagnostic devices, opening up new opportunities and applications for real-time analysis of chemical and biological substances.

BIOIDENT is the first company to combine printed opto-electronic components with microfluidic systems. This combination is enabled by the fluid processability of organic semiconductor materials. BIOIDENT allows printing and integrating of full optical readout systems directly onto microfluidic devices. Organic photodiodes or organic light emitting diodes can be created in any size and shape with specific spectral properties and pre-defined dynamic range. Each photodiode in general comprises of one layer of organic photoactive material sandwiched between two electrodes, one of which is transparent, with an overall thickness of ~500nm. The pixel size can be as small as 50 µm. An equivalent OLED array can be generated using the same fabrication-procedure but different organic materials. In consequence, any combination of light emitting and light detecting diodes can be printed on a variety of substrates for sample illumination and signal detection.



EQUIPMENT

Optomec has just introduced its high resolution M3D Aerosol Jet Printing System. The patented M3D system is said to reduce the size of electronic systems by using nano-materials to produce fine feature circuitry, embedded components and miniaturized devices. M3D offers cost, size and functional advantages, including an ability to produce electronic features that are 10-100 times smaller than competing methods such as screen-printing, inkjet, and thick film lithography. M3D systems are currently being used for applications in the production of Solar, Semiconductor, Fuel Cell, Display and Flex Circuit products. ***[I requested printed samples, but did receive the NanoMarkets PowerPoint, from which the graphs on page 1 were obtained].***

Features	Ink Jet	Screen Printers	M^3D
Minimum line width resolution	~ 30 microns	~ 100 microns	**<10 microns**
Single-pass Layer Thickness	~ 0.1 microns	100 microns	**25 nanometers to 10 microns**
Material Viscosity	10 to 14 cP	>10,000 cP	**0.7-2500 cP**
Material Formulation Time	Years	Months	**Months**
Pattern Generation	Digital - CAD Converted to Raster	Hard Tooling - Screen Template	**Digital - Direct Vector from CAD**
Substrate Requirements	Planar Print head fixed at ~ 1mm above substrate	Planar Screen fixed at ~ 1mm above substrate	**Planar or Non-Planar Head Variable at 1 to 5mm above substrate**