SEMICON WEST 2011: 14 JULY 2011

VENUE: MOSCONE CENTRE, SAN FRANCISCO, US

ON 14 JULY DURING Semicon West 2011, the FlexTech Alliance held its Extreme Electronics TechXPOT session, 'Printed/ Flexible Electronics: Beyond R&D to Real Deal Technologies.'

Semicon West is the flagship annual event for the global microelectronics industry, which is organised by industry association Semiconductor Equipment and Manufacturing International (Semi).

The US FlexTech Alliance, based in San Jose, California, has an established relationship, through its forerunner the US Display Consortium (USDC), with Semi. The latter has played a critical role in setting standards and pulling together different elements of the microelectronics industry; while FlexTech itself, through funding and support programmes, events, and other activities plays a proactive role in fostering the growth, profitability and success of the electronic display and the flexible, printed electronics supply chain.

The Extreme Electronics TechXPOT session, which lasted just under three and a half hours, took place during the morning, in the middle of the main exhibition hall.

Stacy Oresman, FlexTech Alliance's director of technology, explains: 'In the myriad of activity going on during Semicon West, Semi carves out a theatre right in the centre, so it wasn't a workshop or seminar in a traditional sense, as there are lots of companies coming and going.

'Over the course of the session we had about 195 people come and listen to presentations.'

Companies in the audience included Applied Materials, Bosch, Carl Zeiss, DuPont and Samsung.

Attendees

Companies that attended FlexTech Alliance's Extreme Electronics TechXPOT session, at Semicon West 2011, included:

- Applied Materials
- Bosch
- Boeing
- Carl Zeiss
- Dow Corning
- DuPont
- GE Global Research
- Rockwell Collins
- Samsung
- Tokyo Electron

PRACTICAL APPLICATIONS

The session, which included several companies that are beneficiaries of FlexTech's R&D programmes,

like organic solar cell developer Solarmer, had been put together to demonstrate how the printed and flexible electronics industry is moving from R&D into volume manufacturing for practical applications.

The session programme was designed to cater for different levels of understanding of flexible and printed electronics, as well as different parts of the value chain.

'Many had some knowledge, while for those with less the first presentation by NanoMarkets provided the necessary background,' explains Oresman.

Over the past few years the plastic electronics industry has been forced to change its expectations considerably. The first start-ups, which quickly became synonymous with an idea of revolutionary technology promising completely new products and applications for electronics, have paved the way for a more sober and practical approach.

Flexible electronics are seeing practical exploitation where they enable existing microelectronics supply chains to deliver enhanced products.

TRENDS

The presentation by Lawrence Gasman, principal analyst and co-founder of NanoMarkets, summed up the trends that are pointing to a new printed and flexible electronics revolution. He identified cost reduction as the most significant driving force for printed and flexible electronics.

LAWRENCE GASMAN, PRINCIPAL ANALYST AND CO-FOUNDER OF NANOMARKETS
PHOTO: FLEXTECH ALLIANCE

Gasman's presentation also observed that components and materials produce earlier revenues than systems offerings, with nanomaterials offering particularly good prospects. Examples include clear conductive films based on nanomaterials that are being used as transparent conductor in new touchscreen display designs, in place of indium tin oxide (ITO).

At the systems level the short-to-medium opportunities seem to be solution-processed OLED lighting, flexible mobile displays and powered smart cards. At the manufacturing level improved inks and faster printing equipment were identified by NanoMarkets as the main opportunities for plastic electronics.

The rest of the presenters included mainly start-ups developing plastic electronic devices and systems to the established microelectronics industry. Xenon and NovaCentrix are commercialising processes for curing copper inks, based on nanomaterials. Compared with silver, copper is cheaper and can achieve high levels of conductivity.

Xenon supplies high-intensity flash lamps for industrial applications like photovoltaics (PVs), as well as medical and research markets. The company discussed its photonics-based sintering process using low-temperature pulsed light.

DEPOSITION

Presenter Saad Ahmed, engineering manager at Xenon, pointed out that nanomaterials and other high-performance functional materials, processed as inks, require higher or elevated process temperatures, not tolerated by flexible and alternative substrates such as plastics and paper. The challenge is to be able to sinter or cure these advanced inks to create high-performance devices without destroying the substrate beneath.

According to Ahmed: 'Using a pulsed light process, where a very narrow pulse of light that has a huge amount of energy is generated, we can impart a lot of energy onto the substrate for a short amount of time – enough time to melt the metal ink, but not enough to increase the temperature of the material.'

Xenon is targeting its pulsed flash lamp technology at applications for low-temperature sintering

of nanoparticle inks in high-speed roll-to-roll processes, as opposed to low-temperature bake ovens.

NovaCentrix, which started up as a supplier of nanoparticle powders and dispersions, has expanded into designing and developing a whole processing system, including nanoinks for specific printed electronics components and applications, and a tool for sintering and curing its nanomaterials.

The PulseForge system uses high-intensity flash lamps to heat the functional inks or films, but not the substrate itself. The company's latest copper nanoink makes oxidisation part of the solution.

'Instead of fighting oxidation, we begin with particles in their terminal state: fully oxidised,' explained NovaCentrix marketing vice president Stan Farnsworth's presentation.

'There is no conductivity when printed, but this functionality occurs during PulseForge processing.'

NovaCentrix's Metalon ICI-020 copper screen is based on a formulation of copper oxide particles and a reduction agent. After printing, the ink is converted to highly conductive thin-film copper, when NovaCentrix's PulseForge tool is used to modulate a high temperature reduction reaction between the copper oxide and the reducing agent.

The Metalon ICI-020 screen ink, designed for use on paper-based substrates for the smart packaging and RFID markets, costs $75 (€52) a kilogram in volume quantities.

ORGANIC PVS

Another start-up benefiting from FlexTech funding support is Solarmer Energy. The company has achieved successive breakthroughs in the power conversion efficiencies of its laboratory-made organic (O)PVs. In a project funded by FlexTech, Solarmer has developed OPVs close to nearly 12% using high-efficiency donor polymer materials. The project builds on previous designs to make a new active layer material in polymer solar cells that delivers improved properties like low band gap, appropriate molecular energy levels, good mobility and excellent processability.

Vishal Shrotriya, managing director of Solarmer, presented on his company's breakthroughs, looking at markets including building-integrated (BI) PV, portable and off-grid power generation.

COST

According to Solarmer's technology roadmap to 2015, the company will roughly halve the cost per watt of its OPVs year-on-year, calculated on the basis that in 2015 Solarmer has a 278MW production output, at 7% efficiency and a 10-year lifetime, achieving $0.78 cost per watt. Solarmer has installed roll-to-roll production tools to develop a scalable, high-volume and cost-efficient process for making OPVs.

The company's pilot line has a production speed of up to 20ft a minute, an output of up to 3MW annually and has cost $1.5 million to install.

While ramping up production to achieve economies of scale will reduce materials costs, the company is looking to bring about further reductions by replacing ITO as the TCO layer, and replacing the silver back contact with either aluminium or copper inks.

Oresman observes: 'Solarmer is progressing quickly. It has set new records for efficiencies and has installed new production equipment to make that transition from lab to scale up. The company has partnerships in place to provide routes to market. Come 2012 don't be surprised if it has something to announce in terms of commercial plans for its technology.'

Jennifer Ernst, vice president for North America at Thin Film Electronics, discussed her

STAN FARNSWORTH, MARKETING VICE PRESIDENT, NOVACENTRIX
PHOTO: FLEXTECH ALLIANCE

company's progress in high-volume production of all-printed rewritable memory products for consumer application.

Ernst's presentation showed how printed non-volatile (NV)RAM, when combined with printed transistor elements, serves as the basis of a new generation of cheap and disposable electronic devices. The company is working with toy and games manufacturers, and has indicated that commercial launches exploiting its technology are not far off.

In lighting, William Ray, chief scientist at Nth Degree Technologies, discussed his company's approach that uses traditional printing for graphics arts, such as gravure, screen and flexography, to fabricate semiconductors. The company is developing an LED ink to print lighting over a panel that can replace fluorescent lighting.

JENNIFER ERNST, VICE PRESIDENT FOR NORTH AMERICA AT THIN FILM ELECTRONICS
PHOTO: FLEXTECH ALLIANCE

MATERIALS DATABASE

One step toward moving these research technologies into practical production is reliable information on materials properties that clearly specifies just how these properties are measured., so users can compare products.

Erika Rebrosova, assistant professor at Western Michigan University's (WMU) Centre for the Advancement of Printed Electronics (Cape) presented a database being developed for the industry.

Cape has received an award from FlexTech to create the open-access database for accessing technical information on functional materials used in the manufacture of printed and flexible electronics. The aim is to strengthen the printed electronics industry and supply chain, and provide increased access to technical information about available products.

Entries to the database include relevant non-proprietary information about the material itself, information on deposition and post-deposition processes, information on material properties and applications, and vendor information and contact details.

Over 25 companies are in the database, with the number of entries growing. The database will be made available free of charge to FlexTech members and materials suppliers that list their products. Access for those companies that want to use the database as a resource will be subscription-based.

Since launching the session in 2009, attendance has grown 17% annually, with more expected next year as the industry's infrastructure, with FlexTech's support, establishes further and more flexible, printed products, materials, and processes are piloted and commercialised.

According to Oresman the session enables FlexTech to remain up to speed on the commercial progress of its partners, and the wider printed and flexible electronics industry, which in turn helps the organisation create an up-to-date and current programme for its multi-track annual international industry event, held in Phoenix, Arizona, every February. The next one is the 11th Annual Flexible Electronics and Displays Conference and Exhibition, 6–9 February, 2012 +

Breakdown of attendees by role and job type

Corporate level	14
Exec president and vice president level	22
Senior research/scientists and directors	22
Analysts	6
Engineers and engineering managers, managers other and consultants	90
Business development and sales	16
Professors	2
Editors	1
Unknown	22