Organic Electronics

Developing Strategy in a Strategic Market

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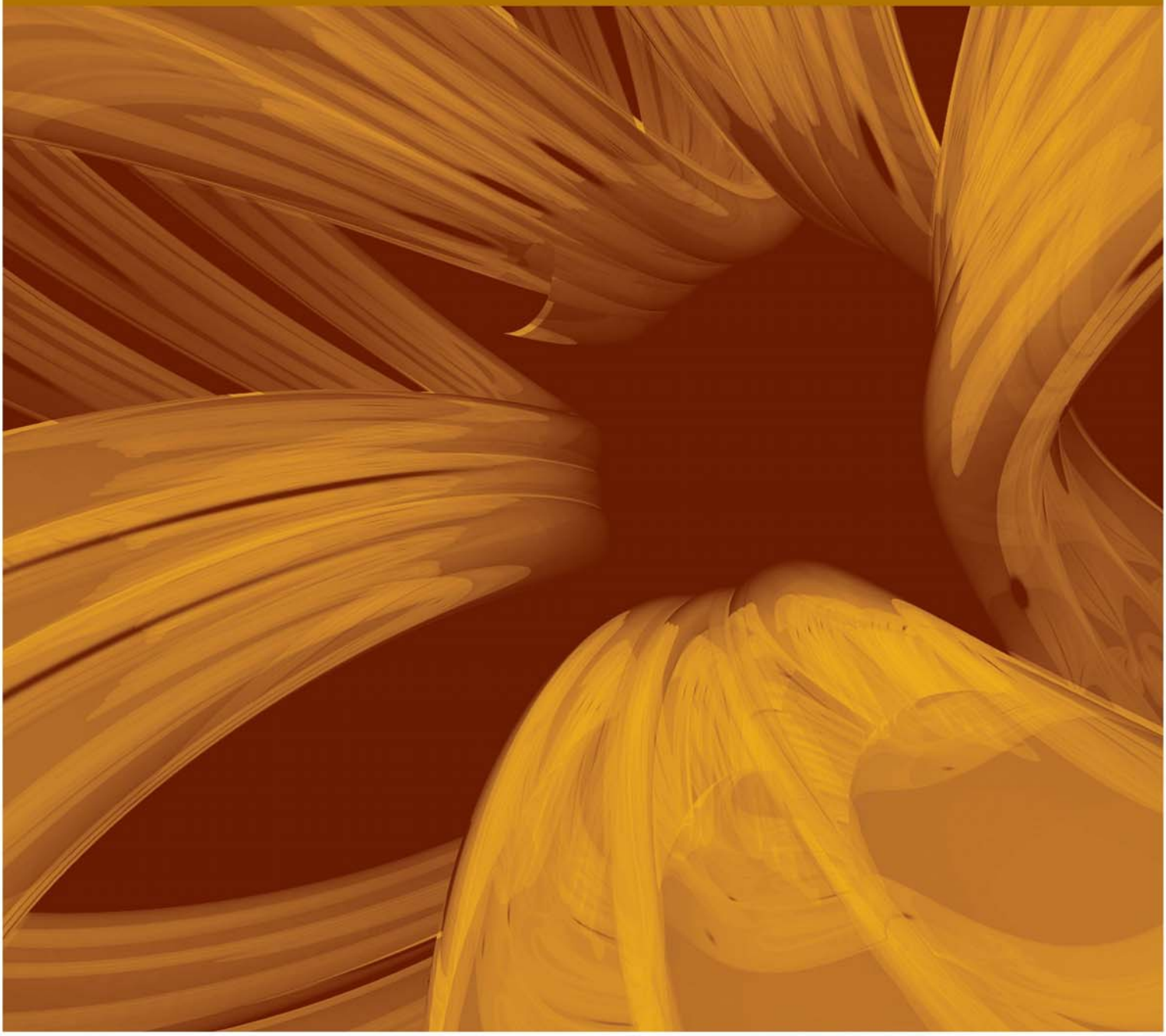


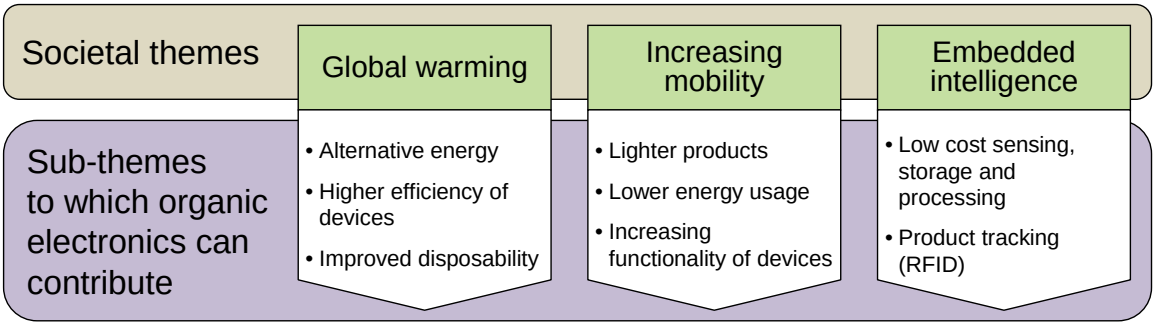
Printed electronics - a technology to meet the challenges of our times

Academic research into conducting polymers has blossomed since their initial discovery in the 1970s, and led to a Nobel Prize in Chemistry in 2000 (A.J. Heeger, A.G. MacDiarmid and H. Shirakawa) awarded for the discovery and development of conducting polymers.

Initially only of theoretical interest, this technology is now capable of offering a wide range of electronic performance previously limited to inorganic materials. These technologies are particularly interesting because they are not only disruptive in the functionalities they convey to products, but also in the breadth of their potential markets. These markets range from displays to re-usable imaging plates, and from rollable photovoltaic membranes to low cost electronic logic. The resulting products are no longer merely concept boards designed to stimulate funding for start-ups, but are the first wave of real commercial products.

Responding to major trends

Organic electronics (OE) can potentially provide radical solutions for three of the over-arching societal themes of our times. As such, OE should be treated as an area for strategic assessment by major corporations and SMEs alike.



OE and global warming

There is general agreement that to reduce the rate of global warming we need to consume less fossil fuel, but that this needs to be done while still satisfying the demand for electricity. A related concern is to reduce the environmental impact of disposing of products when they reach the end of their useful life. Organic electronics offers solutions that respond to each of these themes:

- Photo-voltaic (PV) technologies for generation of electricity from sunlight and other ambient light sources
- Light emitting materials with which high efficiency displays and lighting products can be made

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- Simple, thin device structures that use little material compared with conventional devices and which contain relatively small quantities of hazardous materials

OE and increasing mobility

Consumers increasingly lead lives where they travel more, both for work and for pleasure. At the same time they want to be able to use the same products and services on the move as they do in the office and at home. The result is an increase in the amount of electronic devices, being used whilst travelling. These devices are becoming ever more sophisticated but they also need to be light and have long battery lifetimes. Organic electronics has some inherent advantages in supporting these conflicting requirements:

- Thin, lightweight construction as a result of needing few layers – and potentially using lightweight, plastic or metal foil substrates instead of glass
- High efficiency, direct conversion of electrical energy to light so that devices with displays can have longer battery lives
- New form factors and design opportunities enabled by the use of conformable or flexible substrates

OE and embedded intelligence

Everyday electrical objects, such as washing machines and toasters, are becoming more advanced with the inclusion of microprocessor and sensor technology, leading to more complexity in the product itself. Even low value items, such as toys and greetings cards, are interactive and incorporate a simple electronic circuit. The packaging that carries this product is also increasingly 'intelligent' so that product information and its history can be easily read automatically. There is an opportunity for organic electronics to support these more complex products by:

- Offering the potential for low cost, printable technologies that allow increased design flexibility and lower volume manufacture when compared with using conventional semiconductor devices
- Holding out the promise (at high volumes) of very low cost RFID tags that could make these tags as common as barcodes are today

Organic electronics are already here

Whilst there has undoubtedly been a great deal of hype around the whole area of organic electronics, or 'printed' or 'plastic' electronics as it is often also known, the reality is that the technology is already here. Today we can buy some products with OE components and investors are currently placing huge bets on the future success of other products.

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Existing products

Source: www.sony.com

Small monochrome and colour organic light emitting diode (OLED) displays have been sold in volume for a number of years by companies such as Samsung SDI, RITdisplay and Pioneer. They are typically used in small, mobile devices such as MP3 players and mobile phones where they compete with LCD displays. Total global sales of small OLED displays already amount to more than US$500 million per year. Larger, colour displays are now being launched by the major consumer electronic companies such as Sony and Samsung. For example, Sony's 11 inch colour OLED TV (shown left) has been on sale since the end of 2007. It is only 3mm thick and has an impressive contrast ratio of 1,000,000:1- the ratio between the brightness of a 'bright' and 'dark' pixel. Although Sony's current OLED TV is too small to attract most consumers, its form factor and visual performance illustrate the promise that organic technologies can bring.

Products close to market

In 2007 there were significant moves towards commercialising other OE devices. Plastic Logic raised US$100 million for a factory to produce 'electronic paper' or e-paper (see the illustration on the right). The factory in Dresden will bring together Plastic Logic's organic backplane (the transistor array that controls the pixels) technology with E-Ink's bi-stable display technology to create flexible, low power reader devices. Current e-paper backplanes use silicon transistors to switch the pixels of an E-Ink display on or off, whereas the Plastic Logic version will use printed organic transistors for this purpose. If high volumes can be achieved then using printed transistors could significantly reduce the costs of making the electronic readers.

Source: www.plasticlogic.com

Meanwhile, Polymer Vision is also establishing a factory, in the UK, for rollable e-paper devices using a similar approach to Plastic Logic.

In the photovoltaic (PV) area, G24i began production of ultra-thin organic PV film in 2007 at its factory in Wales. The film, only 1mm thick, is to be used initially to make low cost mobile phone chargers for sale in developing countries.

These examples show that novel display, logic and PV applications of organic electronics are being made market-ready. When added to the existing OLED display market it is clear that organic electronics are no longer a future technology, but very much here and now.

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A complicated landscape

Despite the emergence of real products embodying organic technologies we believe the whole area remains on the border between research and commercialisation. There are many basic technology choices still to be made even in the more established areas such as OLED displays and e-paper devices. These include:

- Whether to opt for small molecule or polymer materials
- Which material to use for the transparent conductor in display and PV applications
- Which substrate materials to adopt and the performance parameters needed from these materials
- How to encapsulate the product to achieve acceptable lifetime and cost

The competitive landscape can be just as challenging to understand, with a mixture of new technology companies vying with more recognised brands. All are trying to establish footholds in what are diverse markets with quite different dynamics and requirements. For example, in OLED emitter materials, leading companies include:

- Universal Display Corporation, which licenses its phosphorescent technology to other companies and uses toll production from PPG for supply
- Merck, which offers both small molecule solutions that usually offer some performance advantages but difficulties in large scale processing, and solution-processable polymeric materials that may offer processing advantages, but at the cost of additional inherent material problems
- Kodak, which both licenses its OLED technology and uses it in-house to make displays for its own products
- Cambridge Display Technology, which specialises in light emitting polymers (now owned by Sumitomo, a major Japanese chemical manufacturer that bought CDT at an unusually high multiple of revenues)
- Idemitsu Kosan, which leads in vapour deposited fluorescent emitters and has just invested in its own manufacturing facilities after previously outsourcing production

These companies differ in their size, the breadth of organic electronic markets that they are addressing and in the range of their involvement in the value chain. What they have in common is a significant pedigree in emitter materials and other organic technologies. Other major material companies, such as BASF, are currently playing catch-up by putting in place collaborative and internal research and development programmes.

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Developing a strategic approach

For a company to develop a clear strategy to exploit the commercial potential of OE, it will need to find answers to a variety of questions. Sagentia has helped many companies to find these answers by supplying insights into the technology, markets and commercialisation strategy, including:

- Which are the most promising markets and when will they start to grow?
- Who are the leading players in each of the markets and what is the competitive intensity?
- What assets does my company possess that can be readily deployed in this area and what will we need to develop or acquire?
- What are the enabling or platform technologies that my company can invest in to mitigate risk?
- What entry method to the market is best for my company?
- What value chain position should my company adopt and how can this be achieved?
- What levels of revenue could be possible for this value chain position?
- With which organisations should my company seek to collaborate in order to access technology or channels to market?
- What are the financial costs and potential returns from being involved in the market?

Summary

Barely a day will go by without a mention of some form of organic or printable electronics in trade or national news sources - it is no longer a question of whether this technology will disrupt the device and electronics industry as we know it, now it is only a question of how widespread it will become, and at what rate.

It’s clear that nimble start-ups have provided much of the early drive in this technology space, but increasingly there are opportunities for large material and device manufacturers who are searching for ways to make money from this disruptive technology. The challenge is how companies can best position themselves for a market that is potentially huge, but requires new applications, new materials, and even new ways of extracting value to be successful.

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Appendix:

Case studies

Case Study 1	Identifying a starting point in organic electronics
Client	A global pharmaceutical and material science corporation
Situation	This company had some competencies spread throughout its many global sites that could be applied to the organic electronics area. However, it had no company-wide coordinated approach to developing technologies and products for specific markets. It wanted to know which markets were both attractive and suited to its existing capabilities.
Approach	Through our own knowledge and a wide-ranging interview programme we defined the key unmet needs in the organic electronics area as a way of identifying the markets most receptive to a new technology provider. We then matched our client's own technology capabilities against the unmet needs to see where the best overall fit occurred. When supplemented by estimates of market sizes we were able to recommend specific product markets on which to focus.
Outcome	The establishment of a focused multimillion dollar research programme

Case Study 2	Development of a second stage approach to organic electronics
Client	An international chemical and pharmaceutical group
Situation	This company had developed a small number of research collaborations in organic electronics in order to learn more about the technologies and markets involved. It now wanted to take the next step and decide where to focus its investments to give the best prospects of commercial success.
Approach	We provided a realistic assessment of the revenue prospects in multiple organic electronic markets and profiled the competitive situation for technology providers in these markets. Following a review of the client's collaborative research portfolio we suggested a re-focus of resources into a smaller number of markets accompanied by an increase in the number and quality of collaborations.
Outcome	Our client accepted our recommendation to widen its collaborations in order to reduce the risk inherent in its limited portfolio and is in the process of selecting the most appropriate partners.

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