

BUSINESS

Display of flexibility

Physicists at the University of Cambridge are leading a revolution in how data can best be displayed. **Katharine Sanderson reports.**

The Cavendish Laboratory in Cambridge, UK, has a storied academic history, with the likes of Ernest Rutherford and James Clerk Maxwell among its alumni. Now in the digital era, the famous laboratory is proving itself no slouch.

Its latest breakthrough came last month, when Plastic Logic — a young company founded by two physicists from the laboratory — said that it had raised about £50 million (US\$100 million) to build a factory that will make flexible displays with organic circuitry laid out on bendable plastic.

The factory will be built in Dresden, Germany, and by 2008 it expects to be producing displays that use flexible plastic semiconductors, instead of glass backing and silicon chips.

Silicon circuitry can't be readily fabricated on plastic because it can be sprayed only when it is hot. But Plastic Logic's tiny, organic polymer circuitry is deposited onto substrates of common plastics such as polyethylene terephthalate (PET) from a solution, keeping process temperatures and costs low. A typical display contains around half a million transistors.

These displays won't displace existing computer screens, most of which are based on liquid-crystal technology and amorphous silicon, any time soon. "It would be madness for a company like Plastic Logic to think that it would compete head-to-head with standard electronics companies," says Henning Sirringhaus, an optoelectronics specialist who was one of the company's co-founders and is now its chief scientist. Instead, it will seek niche applications, hoping to create an entirely new market for flexible, lightweight screens that you can carry about and read on the bus or train.

Plastic Logic was formed in 2000 to exploit research results in organic transistor technology from a team led by Sirringhaus and Richard Friend at the Cavendish. Friend already had one reasonably successful company under his belt — Cambridge Display Technologies (CDT), which has been making organic polymer light-emitting diodes since 1992, and employs around 130 people.



Take it anywhere: plastic displays will provide words where they are needed.

"We believe it is breakthrough-enabling technology."
— Bandel Carano

CDT used organic polymers as the semiconductors in its light-emitting diodes. At the time, these organic semiconductors were not promising candidates to make transistor-based devices. But research into their fabrication continued and by 1999, materials science had progressed to a stage that the organic transistor's mobility — or speed at which electric charge is carried — rivalled that of silicon (H. Sirringhaus *et al. Nature* 401, 685–688; 1999).

Plastic Logic was then established to exploit this promise commercially. The young company brought in an outside chief executive from the start, Stuart Evans, who already had experience of founding start-up companies such as Cotag International, an early innovator in electronic tagging based in Cambridge.

The company initially raised £1.8 million after persuading Hermann Hauser, co-founder of Cambridge-based venture-capital company Amadeus, that its technology was ripe for commercial development. Other partners at this stage included local venture-capital company Cambridge Research and Innovation and the chemicals giant Dow Chemical. Three funding rounds between 2002 and 2005 raised another £20 million.

But the company's biggest break came when a group of US investors, led by Palo Alto venture-capital firm Oak Investment Partners in California and Tudor Investment of Greenwich, Connecticut, agreed late last year to back the ambitious factory construction plan. "We

closely monitored the company's progress for several years," says Bandel Carano, a partner at Oak. "We believe it is breakthrough-enabling technology."

Barry Young, vice president of DisplaySearch, a market-research firm based in Austin, Texas, says that investors are right to be confident that the flexible displays will find buyers.

Newspaper publishers and the book industry are among those with a strong incentive to make sure that handy, lightweight devices soon become available for displaying the printed page.

But he cautions that the success of the company will depend on it being able to create new devices that people actually want to buy. "They are going after a market that doesn't exist," he says, adding that the \$100-million investment is "a giant amount for a company with no defined market and no revenues."

Plastic Logic is keeping details of its first product secret for now. It will probably have to team up with consumer-goods manufacturers to find the 'killer application' that will make it succeed, analysts say.

As it continues on that quest, managers at Plastic Logic are hoping to benefit from a robust infrastructure that has been built at Cambridge to help young companies along. For example, the university's new Integrated Knowledge Centre, which has received £2.3 million from the UK Engineering and Physical Sciences Research Council, will house engineers and scientists to investigate and manufacture new approaches to photonics and electronics. In their roles as academics, Sirringhaus and Friend are both part of the project, and Plastic Logic is one of the five commercial partners involved with the centre.

The Dresden factory will be a scaled-up version of Plastic Logic's prototype production line in Cambridge, and will employ 140 people. Because of the high cost of land and labour, Cambridge was never in contention as a location for the factory, Sirringhaus says. Dresden was chosen because it is an emerging hub for the electronics industry in Europe (see *Nature* 441, 931; 2006) and because the state government of Saxony will provide an undisclosed cash incentive.

Plastic Logic is unlikely to find that established manufacturers of liquid-crystal displays give up ground easily, however. To compete against them, Plastic Logic's products will have to be cheap, as well as flexible and robust. "Nobody underestimates the challenge ahead," says Sirringhaus.