

Plastic may spell the end of the silicon microchip

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The list of achievements of Cambridge University's Cavendish Laboratory – one of the world's most prestigious centres for physics research – is about to get a little longer.

Responsible over the past 136 years for a stunning series of discoveries, from elemental particles such as the electron to the threads of genetic material known as DNA, the laboratory can count among its more recent breakthroughs a form of circuitry that could change radically the world's electronics industry.

In 2000 Plastic Logic, a Cambridge-based start-up company, announced it was attempting to commercialise a form of plastic electronics that had developed from research at the laboratory.

By using a cheap and simple set of processing operations to build up layers of circuitry on plastic "substrates" – the material on which circuits are formed – rather than silicon wafers used in conventional microchips, the developments promised to slash the cost of making semiconductors.

That was potentially a step forward of enormous significance: over the past 50 years semiconductors have grown into a huge industry fundamental to just about every form of economic activity.

But while Plastic Logic continued to develop further the technology behind plastic circuits without going so far as to put its new devices into production, the ideas behind its creation could easily be dismissed as little more than an academic curiosity.

What has given the science behind the company more substance is today's announcement that Plastic Logic has attracted \$100m (£51m) of investment that will fund a plant to make plastic semiconductors – the first of its kind in the world. The factory should be in operation in Dresden, Germany, by the end of 2008 and employ 140 people.

This will create a swell of pride among the two Cavendish professors who are closely associated with Plastic Logic: Henning Sirringhaus, a solid-state specialist who is chief scientist at the company and a non-executive director; and Sir Richard Friend, head of the laboratory and one of the founders of Plastic Logic.

The Cambridge connection is reinforced by two other non-executives who have strong Cambridge ties. They are Lord Alec Broers, a former semiconductor expert and the immediate past vice-chancellor of Cambridge University, and Hermann Hauser, an alumnus of the Cavendish laboratory who is one of the UK's most noted technology entrepreneurs.

Mr Hauser – who in 1978 co-founded Acorn, one of the world's first home computer companies – is a director of the Amadeus venture capital group that was an early investor in Plastic Logic.

However, news that a plant is to be built will create a stir far beyond Cambridge. Morry Marshall, vice-president for strategic technologies at Semico, a Phoenix-based semiconductor research group, says plastic semiconductors have "tremendous potential" and add up to a "breakthrough that is waiting to happen".

The initial products from the factory will be pieces of plastic about A4 size. The basic plastic substrate will be polyethylene terephthalate, a form of plastic used to make drinks bottles.

"I would not be surprised if Prof Sirringhaus gets a Nobel prize for his achievements in this technology," says Mr Hauser.

By 2009 the Dresden plant should be producing 2.2m units of A4-size semiconductor sheets a year. They will initially be used as flexible "control circuitry" for large displays the size of a piece of paper that can hold large amounts of information – equivalent to thousands of books.

The displays will most likely be made by other electronics companies, with Plastic Logic providing the crucial control circuitry and possibly licensing its designs.

Mr Hauser adds: "We hope to make it as easy to carry around large amounts of written information using devices based on our technology as it is now to have easy access to large amounts of music using an iPod or MP3 player."

The distances between adjacent circuitry lines in the plastic semiconductors due to be made in Dresden will be 5-10 micrometres (5-10 millionths of a metre) which is a lot higher than the nanometre (billionths of a metre) dimensions of

the latest silicon semiconductors.

But under development in Plastic Logic's research operations are plastic circuits that are just 60 nanometres in dimension, says John Mills, chief executive officer, holding out the possibility that before long the electronic characteristics of the company's plastic devices might not be too different from those of conventional silicon chips.

At that point, says Mr Hauser, the world may be ready to embrace a new form of microchip – based on the A4 sheets due to emerge from the Dresden plant but a lot smaller – that could be cheap enough to do jobs for which current silicon devices are too expensive.

For instance, the chips could form part of cheap toys that tell children how they are to be used or, depending on how they are programmed, remind them to do their homework. "Plastic electronics could lead to a fundamental revolution in the way the electronics industry evolves", says Mr Hauser.

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