The Company

- Spin-off from Cavendish Laboratory
- Leader in plastic electronics display technology
- 80 patents filed and 20 granted
- Mountain View CA - Product development
- Cambridge, UK - R&D facility
- Dresden, Germany - Manufacturing facility

200 Professionals Focused on the E-Reader Opportunity!
Enabling Display Technology

Revolutionary form-factor, industrial design for flexible, thin and light plastic displays
Our Mission

Develop a Revolutionary New Product and User Experience for the Business User that Delivers the Following:

- **Creates** an innovative new e-reader display that will change the way people acquire & consume digital content
- **Connects** the product to an open content delivery platform that allows users simple access to global business content
- **Enables** publishers and strategic partners to reach new and existing customers to develop new sources of revenue
Plastic Logic Timeline

Technology Development

2000: Spinout from Cavendish
2004: Proof of concept validation

Flexible Display Module Manufacture

2006: Focus business on display manufacture
2007: Break ground on Dresden factory
2008: First displays from factory

Product Company

2007: Open California Office
2009: Product Trials
2010: Product Launch
What investors look for

- Large and fast-growing market opportunity
- Team and Technology
- Business model that can take advantage of the opportunity

- The vision of plastic electronics was main motivator in investment
Solution-processed polymer transistors

Benzene: \[ \text{Energy \ LUMO} \]

Polymer \[ \Phi \]

Disorder = Low charge mobility
Self-organisation to improve performance

Ordered microstructures induced by polymer self-organisation (phase separation, liquid crystallinity, hydrogen bonding, …)

Resulting in order of magnitude enhancement of field-effect mobility.

Mobility now approaching that of thin film a-Si

Sringhaus et al., Nature 401, 685 (1999)
Electronic manufacturing by printing

Conventional semiconductor manufacturing – subtractive patterning

Solution-based printing – Additive patterning
Challenges

Complete set of solution-processible electronic materials:

- Semiconductors, dielectrics and conductors
- Control of interfaces
- Materials purity → Operational stability, reliability

Short-comings of graphic arts printing techniques:

- Limited resolution of 50 μm
- Poor layer-to-layer registration accuracy
- Graphic print much more fault tolerant than electronics

Science 290, 2123 (2000)
Silicon versus Plastic

Silicon industry has been working for 50 years, plastic has got to move up the curve in 10

Plastic should find places silicon can’t go or find hard to go

- Plastic substrates
- Large-area electronics
- Low-temperature manufacturing
- Low cost for applications requiring only small transistor numbers / low transistor density
- Ease of integration with light-emitting, light-detecting, energy, sensing and memory functions

Multi-disciplinary challenges
Considerations at the start

- Solution to a problem?
- Market focus?
- Is timing right?
- Strong IP position with clear IP ownership.
- Commercial focus from the outset; Need to build a strong, devoted team.
- Appropriate balance between scientific career and support for company.
- Support infrastructure (Technology Transfer Office, local VCs & lawyers).
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From ten to a million transistors

- Robust and scalable processes
- High level of process control
- Invent only where necessary
- Use available manufacturing equipment whenever possible
Why not do this with current display technology?

- **Readability**
  - LCD screen cannot be read in bright sunlight
  - PL displays are reflective like paper

- **Battery Life**
  - Laptop battery life is 2 hours
  - PL displays are bi-stable: battery life can be weeks

- **Breakable**
  - Large area LCD screens on glass are very fragile
  - Our displays are built on plastic substrates thus very robust.

- **Lightweight**
  - A4 LCD glass substrate: 170 g (PL substrate 20g)
  - PL displays can be handheld for extended periods without fatigue.
Electrophoretic Display Media

Principles of Operation

• Oppositely charged reflective submicron pigments are encapsulated in a clear liquid
• Particles move in opposite directions in an electric field
• Partial capsule imaging is possible enabling high resolution capability

Cross-Section of Electronic-Ink Microcapsules

Top Transparent Electrode

Positively charged white pigment chips

Clear Fluid

Sub-capsule addressing enables hi-resolution display capability

Negatively charged black pigment chips

Bottom Electrode

Light State  +  +  Dark State  -  -

Note: For illustration purposes only - not drawn to scale. Copyright E Ink, 2003.
Display construction simpler than LCD
Plastic Logic’s Manufacturing approach

- **Solution processable polymer semiconductors and dielectrics**
  - Good environmental and operating stability
  - Excellent mechanical properties ⇒ No cracking upon flexing
  - Room temperature processing ⇒ Compatible with low-cost PET substrates

- **Manufacturing process based on direct writing technologies**
  - No repetitive mask alignment required ⇒ Scalable to large substrate size
  - Direct-write distortion compensation ⇒ High registration accuracy

- **Multilayer pixel architecture**
  - High-aperture ratio / resolution for optimised front-of-screen performance
  - Made practical by ease of solution-based multi-layer deposition
Cambridge prototype line (2005)

- Display in a day
- 14” substrate capability
- Manual substrate handling, some key steps automated
Developments always take a little longer than the market projections
The power of demonstrators

First product, representative demonstrator Oct 2006
Industrialization of flexible displays

- Private financial funding of > $100 million in 2007 for a production facility
- World wide selection process of a production location
  - More then 200 locations evaluated
- Decision to develop a manufacturing facility in “Silicon Saxony” region of Dresden, Germany for volume production in 2009
- Why Dresden?
  - Excellent local support in all areas, ground, work force regulations etc.
  - Development Grants
  - ‘Green field’ development
  - Experience and infrastructure for R&D and volume electronics manufacturing → People
Raising Money – Timing is Everything

It takes six months to raise money.
There is one six month slot in the year.
Plan for everything to take much longer than it should.
Raise as much as you can – you never know when you will need it!
Balance the team to deliver the product

People tend to hire in their own image
May not understand other groups work or motivation
Needs management and education
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Factory Location
Dresden Factory
Adopting proven automation methods
Production technology transfer challenges

- **People:** No people with OSC manufacturing expertise in the region but process engineers, equipment technicians from semiconductor manufacturing

- **Equipment:**
  - We are working with equipment vendors from Japan, USA and Europe
  - Wherever possible standard flat panel display manufacturing equipment is used but some modification / development of new equipment was necessary
  - Also the flat panel industry is not located in Europe: no infrastructure for service, no CE marking

- **Materials:** We had to set up the use of new special materials with our suppliers for volume production (handling, specification etc.)

- **Manufacturing systems:**
  - A factory integration and manufacturing execution system (MES) for this equipment concept is mandatory
  - Set up of local services (Failure analysis) and R&D cooperation
There's usually more than technology to develop.
Need to consider everything that the business needs to be successful.
Bill Davidow (ex-VP Marketing at Intel, founder Mohr Davidow Ventures) called this Device versus Product.
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E-Reader market is taking off

2-3 million e-readers will be sold in US in 2009

- Sony Reader 5”-7” product range launched in ‘09

- 8.1” iRex Technologies Iliad launched ‘09. Includes stylus-based touch panel input

- 6” Amazon Kindle 2, launched ‘08. Wireless download of electronic books from Amazon website
Our Product

A Innovative New Device Dedicated to Reading!

- Unlike Any Other eReader Available
- Large Display Optimal for Branded Content
- Thin and Light Weight
- Rugged – Will Not Break Like Glass
- Intuitive Touch Screen Interface
- Simple Access to Published Content
- Captures Advertising Opportunity
- Partnership Focused Company
US Market Solution Offering

**Product**
- First generation product will launch in Q1 2010
- Thinnest, lightest and largest in the market
- On-device content store

**Content Platform**
- Service bureaus established to easily ingest and optimize publisher content
- End user can browse and purchase content from the device or web

**Ecosystem Partners**

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<th>NETWORK SERVICE PROVIDER</th>
<th>WEB STORE</th>
<th>CONTENT PRODUCTION</th>
<th>SAMPLE LEADING PUBLISHERS</th>
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Biorhythms And Business Rhythms

Are your cycles aligned?
Are you speaking the same language?
Series A, B, C
Motivation

Employees
  Job satisfaction
  Getting the idea into production

Money
  Compensation
  Shares
  Do they mean anything to the employees

Who is taking the risk?
  Risk/rewards shifts with funds raised from founders towards capital
  Impact on motivation
The Plastic Logic reader