VTT TECHNICAL RESEARCH CENTRE OF FINLAND

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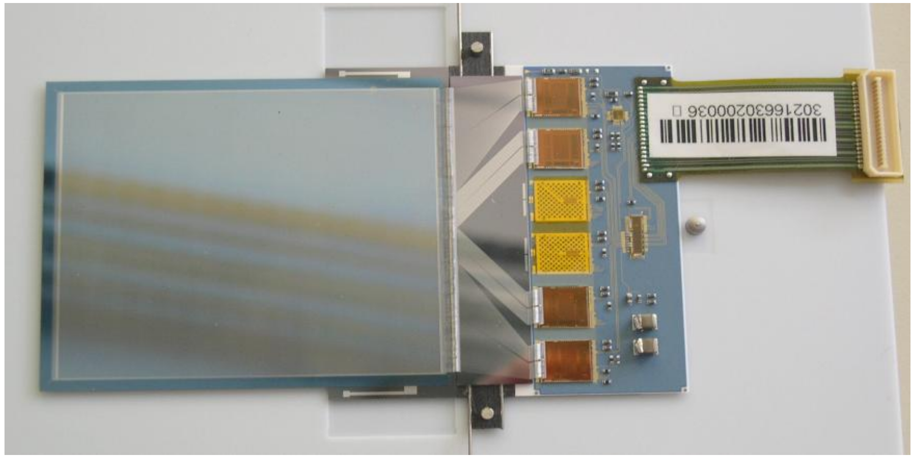
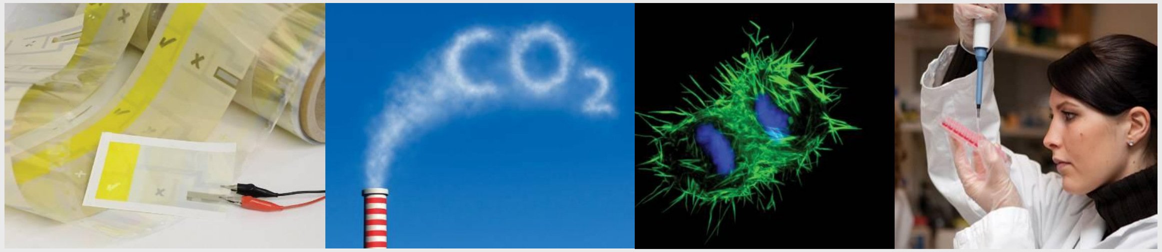
Business from technology

Outline

- VTT in Brief
- Process resources
- Process capabilities
- Bottle necks and risks
- References



VTT in brief



Customer sectors

- Biotechnology, pharmaceutical and food industries
- Electronics
- Energy
- ICT
- Real estate and construction
- Machines and vehicles
- Services and logistics
- Forest industry
- Process industry and environment

Focus areas of research

- Applied materials
- Bio- and chemical processes
- Energy
- Information and communication technologies
- Industrial systems management
- Microtechnologies and electronics
- Technology in the community
- Business research

- Turnover 245 M€
- Personnel 2,700
- 77% with higher academic degree
- 6,200 customers
- Established 1942
- VTT has been granted ISO9001:2000 certificate.

VTT's operations

Research and Development ■ Strategic Research ■ Business Solutions ■ Ventures ■ Expert Services ■ Corporate Services

Public decision makers, financiers and R&D performers

Parliament of Finland

Council of State

Research and Innovation Council

Ministry of Education

- Academy of Finland
- Universities

Ministry of Employment and the Economy

- Tekes, the Finnish Funding Agency for Technology and Innovation
- VTT

Other ministries and research institutes

- Sitra, the Finnish Innovation Fund
- Finnvera
- Finpro
- Finnish Industry Investment Ltd

TE-Centres

VTT SERVICES

MICRONOVA CLEANROOMS

Main Cleanroom Characteristics

Total Area	2 600 m^2
Cleanroom Classification	ISO 4…ISO 6
(in clean bays)	(10…1000)
Temperature	21 °C ± 0,5 °C
Relative humidity	45 % ± 5%

Clean bay - Service chase type
Ventilation based on filter fan units
Raised perforated floor
Subfab with technical support areas

Labs with built-in Cleanrooms

Micropackaging lab - dicing saws, wire bonding

SubTech lab - Ion implantation, CMP, backgrinder, wafer bonder

Process equipment is mainly for 150 mm wafer size, but some processes can be performed also on 200 mm wafers

Equipments

Furnace:

- oxidation, LTO, TEOS, Nitride, doped and undoped polysilicon
- 2 Centrotherm furnace stacks

Lithography:

- Contact aligners – MA150 and MA6 (bottom side alignment), MA200
- E-beam writing – Zeiss LEO 1560
- Step and Stamp Imprint Lithography – Suss MicroTec NPS 300
- i-line stepper, Canon FPA 2500i3
- Resist/development tracks, Suss ACS 200 and AIO Duna 700

Dry etching

- Etchers for silicon oxide, nitride, metals - LAM 4520/4420/9600
- Deep silicon etching - Aviza Omega i2L and STS ASE
- Silicon oxide ICP etching – STS AOE
- RIE – Oxford 80Plus
- Plasma strippers (PRS 800/801), microwave asher (Aura 1000), wet ozone stripping

Ion Implantation

- Medium current, 200 keV, P, As, B – Eaton NV8200-P

Equipments

Sputtering: AlSi, Mo, TiW, Si - Provac LLS 801

PECVD: Silicon oxide and nitride, incl. TEOS-process

Electroplating:

- Ni, Cu, SnAg, SnPb and SnBi – RENA and home-built plating systems

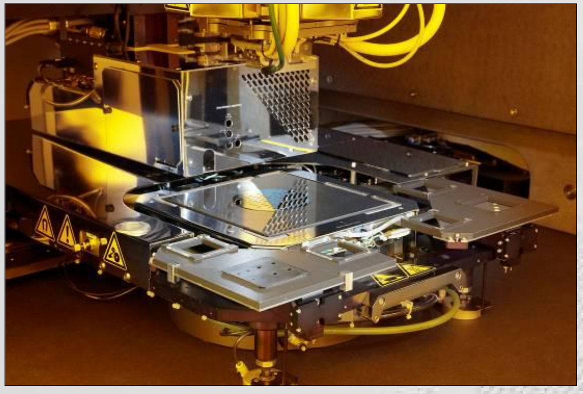
Flip-chip bonding: 2 Suss MicroTec FC150 bonders

Dicing: Disco DFD 651 and Loadpoint uAce-352

Fusion wafer bonding: EVG 5201S and EV 801 (non-IC materials)

Backgrinding (wafer thinning): Strasbaugh 7AF

Polishing and planarization: Strasbaugh 6DS-SP



Process capabilities (case example)

AC-COUPLED DETECTOR PRODUCTION PLAN (POLY RESISTOR)

- 5 mask levels (alignment, strips, poly, contact, metal)
- Target capacity: 10000 wafers in 3-4 years -> 2500-3500 wafers/year -> 250-300 wafers/month.

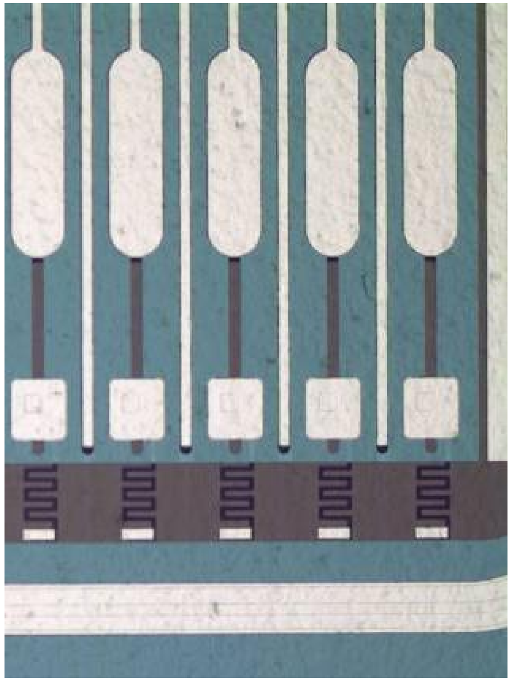
Process time consumption (100 wafers)

TOTAL EQUIPMENT TIME: 311 h

TOTAL OPERATOR TIME: 174 h

EQUIPMENT TIME BREAKDOWN

• CLEAN	18 h (6%)	Furnace (21%)
• OXIDATION (+ANNEAL)	33 h (11%)	
• POLY GROWTH	14 h (4%)	
• LITOGRAPHY	130 h (42%)	
• ION IMPLANTATION	53 h (17%)	
• WET ETCH	11 h (3%)	
• PRS	12 h (4%)	
• POSISTRIP	16 h (5%)	
• AL SPUTTERING	24 h (8%)	



Bottle necks and risks

Target capacity of 250-300 wafers/month reachable if processed in 5-shifts.

- Current work shifts and process equipment usage:
  - ➢ Delivery in 6-7 weeks (4 weeks of operator time -> parallel processing).
- Processing in 5 shifts (24/7):
  - ➢ Delivery in 2 weeks (1 weeks of operator time -> parallel processing).
  - ➢ Requires a strong effort to execute.

Bottle necks:

- Lithography (42%) -> 2 resist & develop tracks and 2 mask aligners
- Implantation (17%) -> **1 ion implanter**
- Furnace (21%) -> **2 high temperature diffusion and 1 poly furnace tubes -> investment to new furnace stack in 2010.**

Risks:

- Highest risk for delay in ion implantation -> require back-up service.
- High temperature processes are long and also occupied by several other processes -> clear coordination of the processes.
- Process quality -> process quality need to be monitored systematically.

References: Silicon production and packaging

Silicon trackers
- LEP – DEPLHI experiment: complete Si inner barrel and multiple ladder detectors, 1994.
- Beam telescope Si detectors for HIP - 1996.
- Stereo angle detectors for CMS - 1995.
- Multiple small components sold to Fermilab and ESRF.
- Very thin strip detectors on SOI for JET Neutral Particle Analyzer - 2006-2007.

Silicon X-ray detectors
- Pixel detectors for Sixa and EXIST space satellite projects - 1995 and 2003 .
- Delivery of about 3500 diodes to Oxford Instruments X-MET 3000 TXR X-ray fluorescence instrument – since 1996.

Dosimeter Silicon diodes
- 60-70000 diodes for RADOS - RAD-60 Personal Alarm Dosimeter – since 1993.

Silicon photodiodes (PD)
- PD matrix production for CT imaging with through wafer interconnection for Detection Technology – since 2003.
- LIDAR devices for NOPTEL – 1993-2002.
- Large area High Quantum efficiency photodiodes for European customers – 2008-2009.

Flip-chip bump bonding
- The LHCb RICH Industry Award in 2006 - 240 5x1 SPD modules (~10 million pixels).
- The ALICE ITS industrial Award in 2008 - 830 single assemblies for HPD anodes.
- Pixel sensor ladder production to Fermilab for PHENIX project – since 2004.

VTT creates business from technology