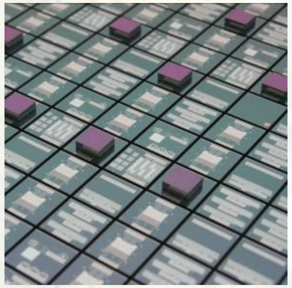
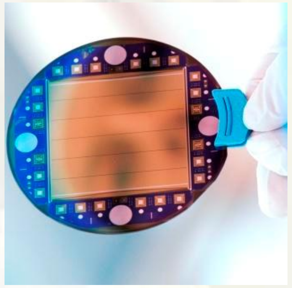
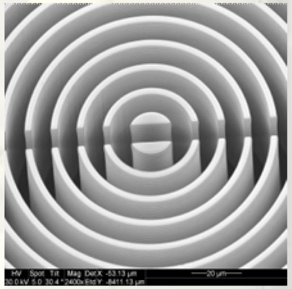
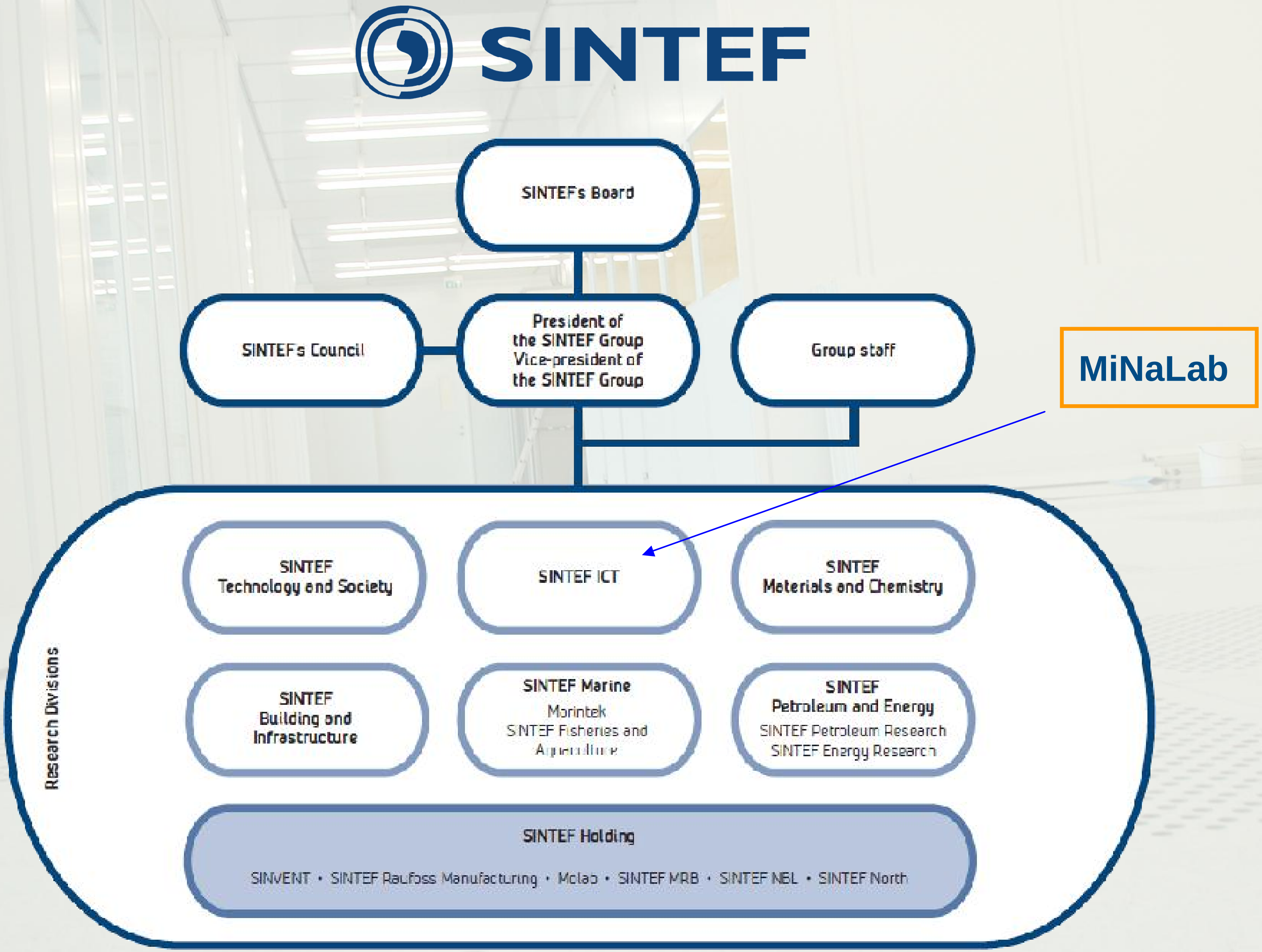
SINTEF MiNaLab
Microsystems and Nanotechnology

Chief Scientist Thor-Erik Hansen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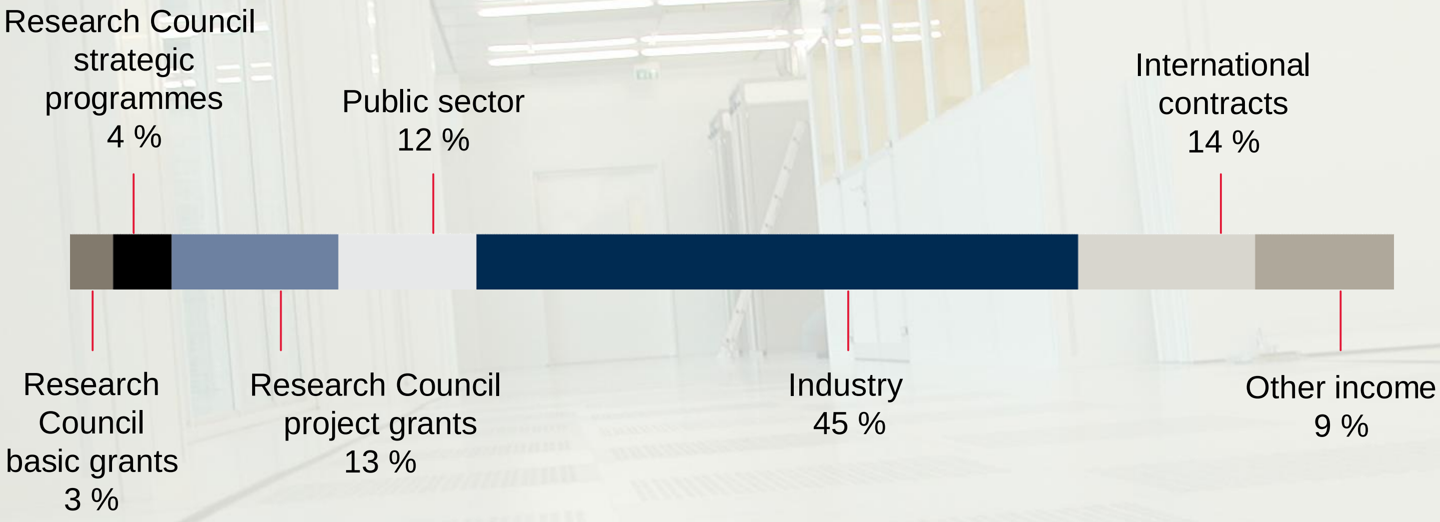
SINTEF revenues



SINTEF turnover in 2008: NOK 2.6 billion (295 M€)

MiNaLab

- Turnover 2007: 53.4 MNOK (~ 6,1 M€)
- Turnover 2008: 58.3 MNOK (~ 6.6 M€)

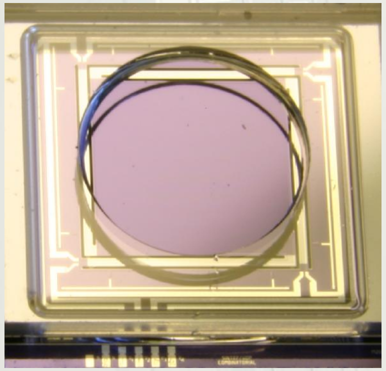
- Employees: 39
  - Scientists: 28 (16 with PhD)
  - Engineers: 11

- QA system approved to ISO 9001:2000

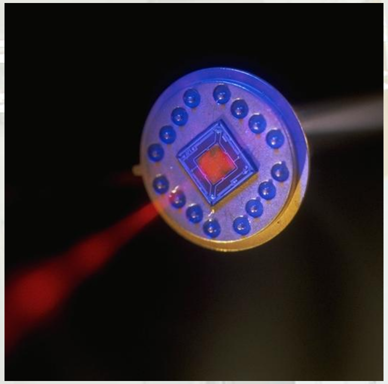
MiNaLab (Micro- and Nanotechnology Laboratory in Oslo)

- Moved into new lab in 2005
- Shared facility with the University of Oslo
  Two separate clean room floors:
  SINTEF: 800 m^2
  University of Oslo: 600 m^2
- SINTEF:
  - Silicon production line with annual capacity of 10.000 150 mm wafers on one shift
  - 100 mm and 150 mm wafers
- Situated on the University of Oslo campus.

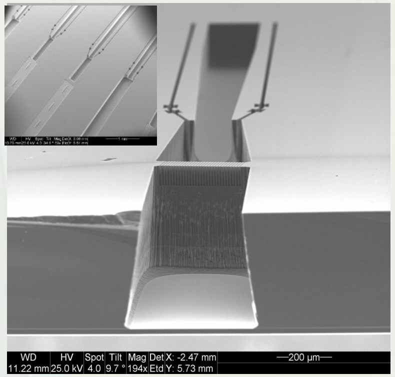
Main research and development fields
sensors and actuators



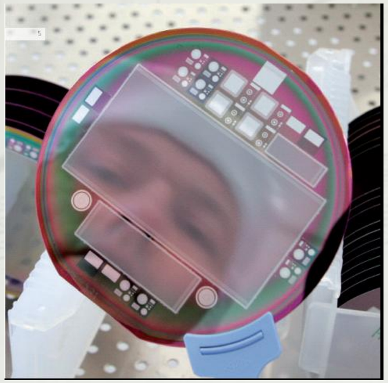
MEMS



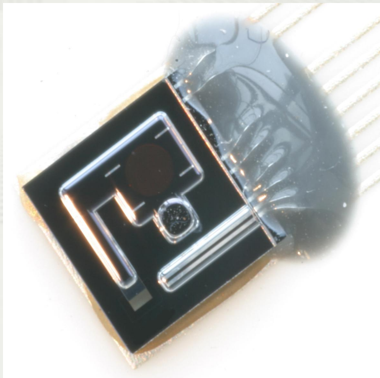
Diffraction micro-optics



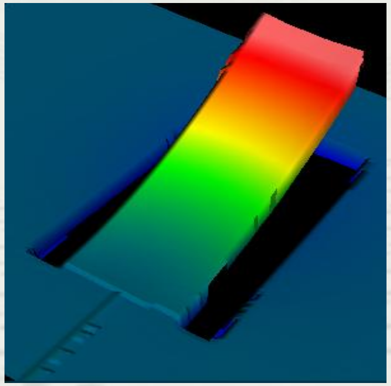
Advanced processes



Radiation detectors



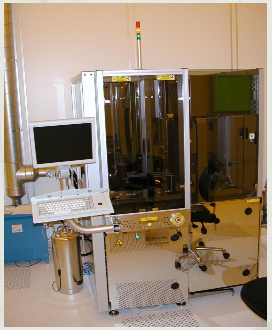
Micro-fluidics



Functional materials (PZT)

Examples of Processing Equipment

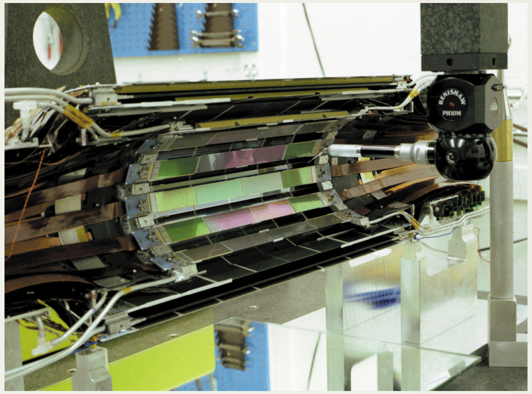
- Diffusion / oxidation furnaces
  - Totally 12 horizontal and 4 vertical tubes



- Automatic mask aligners and coaters
  - Contact / proximity printing
  - Front to back-side alignment

- Plasma tools
  - **4 state of the art Alcatel plasma tools**
  - **PECVD deposition Si3N4, SiO2**
  - **RIE and DRIE etching of silicon, SIO2, Si3N4, poly-silicon**

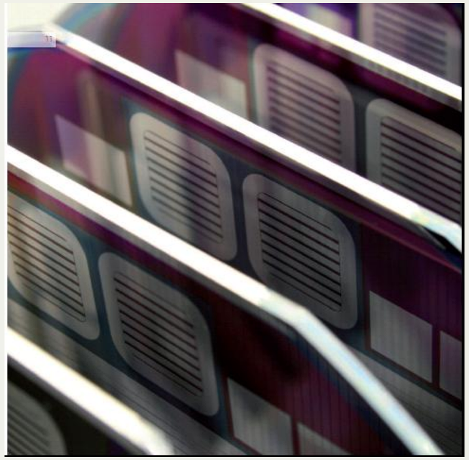
Radiation detector reference projects



High energy physics

- Single and double sided strip detectors with AC coupling, DEPLHI micro-strip detector, CERN, 1988 -1995
- Macro-strip detectors, DELPHI tracker, CERN, 1985 -88
- Photodiodes for scintillator readout, DELPHI calorimeter, CERN, 1986-87
- Silicon drift chamber, STAR detector, Brookhaven NL, 1997-98,
- Double sided strip detectors, Athena detector, CERN, 1999 – 2000
- Single and double sided strip detectors, HERA B detector, DESY, 1997 -2000
- Double sided strip detectors with AC coupling, Alice detector, CERN, 2002 -2006
- Double sided pixel detectors, CMS detector, CERN, 1999 – 2006
- Pixel detectors, INFN Pisa /CERN, 2006 - 2007

Radiation detector reference projects



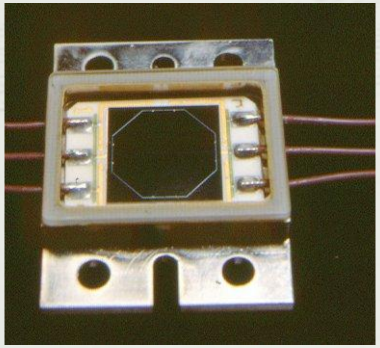
X-ray and γ- detectors

- **Double sided macro-strip detectors, 2 mm thick, NRL 2005 – 2009**
- **Pixel detectors, 2 mm thick, NRL 2003 – 2005**
- **Pixel detectors, Cornell University, 2006 – 2009**
- **Single and double sided strip detectors with AC coupling for material analysis, non-disclosed European and US industrial customer, 2003 –**
- **Strip detectors for medical imaging, non-disclosed European industrial customer, 2004 -**
- **Edge-on detector for material analysis, non-disclosed European industrial customer, 2006 –**
- **XRF – detector for material analysis, non-disclosed European industrial customer, 2009 –**
- **Drift diodes for material analysis (double sided with up to 17 mask layers), 2 non-disclosed US industrial customers, 2004 -**

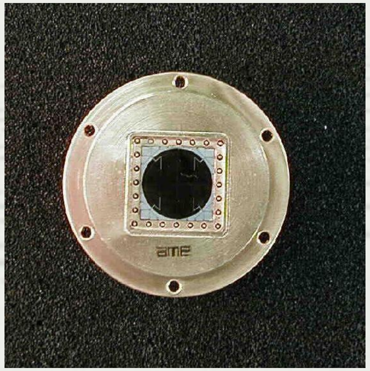
Radiation detector reference projects

Photodiodes

- AME (OSIO Norway since 2006) has produced photodiode chips at SINTEF since 1985
- PIN – diodes and quadrants for NIR (800 to 1064 nm)
- UV-, blue- and VIS- diodes, sun sensors, PSDs
- Avalanche photodiodes (APDs) for NIR (RCA structure)
- High end industrial applications, since 1987
- Defence applications, non-disclosed European defence customers, since 1987
- Space applications, Officine Galileo, Astrium, ESA / ESTEC, TNO-TPD, ISRO /SAC (India), LEOS (India), since 1989



Cryogenic Quadrant Photodiode (CQP), ISO Mission

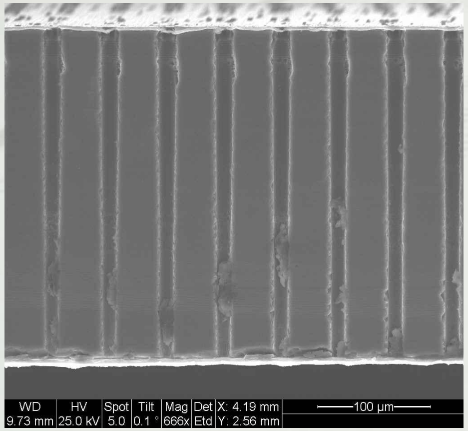


Virgo LOI Detector, SOHO Mission

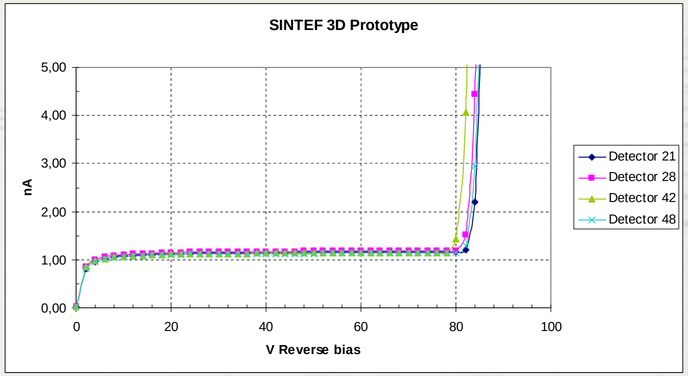
Radiation detector research project

Full 3D-detectors with active edge

- Detector chips with vertical n- and p- electrodes, and active edge trenches filled with poly-silicon. Superior radiation hardness
- SINTEF member of 3D-consortium with Manchester U., Stanford U. / SLAC, Purdue U., Hawaii U., Prague TU.
- SINTEF 2nd lab in the world to demonstrate working prototypes of full 3D - detectors (made on n-substrates with active edge sensitive to dicing)
- 2nd lot on p-substrates currently in production. Includes ATLAS FE-I4 chips, CMS-chips, and Medipix chips on same wafer



DRIE etched 14 µm electrodes through 320 µm thick wafer on oxidized support wafer



IV- characteristics measured on first SINTEF 3D lot. ATLAS chip with 2700 pixels. 4E configuration

Risk analysis volume production at MiNaLab

Item	Risk	Mitigating actions
1	Combined research and volume production in same lab may to lead to conflicts and reduced efficiency	Set up dedicated production line inside lab (equipment and people)
2	Cost structure and ability to meet price targets. Problems to compete on price with dedicated production companies	a) Dedicated production line b) Focus on special products c) Compete on quality and performance c) Form alliances to share work
3	Limitations in production capacity	a) Invest to remove bottle necks b) Outsource process steps c) Form alliances to share work /projects

Thank you for your attention!