Overview of VTT’s activities in photonics, semicon, MEMS and printed intelligence

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Finnish-Dutch matchmaking mission, October 4, 2018, Nijmegen, The Netherlands
VTT Technical Research Centre of Finland Ltd

BASIC RESEARCH

APPLIED RESEARCH

DEVELOPMENT

UNIVERSITIES

INDUSTRY

15.10.2018  VTT – beyond the obvious
VTT Technical Research Centre of Finland Ltd

- VTT Group:
  - VTT
  - VTT Memsfab
  - VTT Ventures

www.vttresearch.com
#vttpeople
@VTTFinland

Established in 1942

269 M€
Net turnover and other operating income (VTT Group 2016)

2,368
Total of personnel (VTT Group 2017)

33%
from abroad (VTT Group 2016)

27%
Doctorates and Licentiates (VTT Group 2017)

Owned by Ministry of Economic Affairs and Employment

2018 VTT – beyond the obvious
R&D and pilot production infrastructures

- Micronova, Espoo
  - 2 600 m²
  - Class 10-100
  - 150 mm wafers

- PrintoCent, Oulu
  - R2R pilot environment for printing and hybrid manufacturing
Silicon photonics on 3 µm SOI

Benefits of “Thick-SOI”:
- Low optical losses (0.1 dB/cm)
- Ultra-dense integration
- Dual-polarization operation
- Tolerates high optical power
- Ultra-broadband SM operation

Extreme light confinement:
- SM rib waveguides
- MM strip waveguides

Euler bend

Long & compact delay lines
- 1.5 m long!
- 4.4 mm

Under development:
- Fast modulators & PDs
- Monolithic isolator
- Monolithic spot-size conversion for SSMF

We are looking for III-V chips and partners for scalable assembly/packaging
Hyperspectral imaging

Miniaturization enables novel applications

- Customized miniaturized hyperspectral imaging solutions based on Fabry-Perot interferometers
  - UV, visible and NIR to SWIR and thermal IR
- Expertise in designing and realizing demanding HSIs for high-performance applications in space, medical, remote-sensing drones and precision agriculture
- MEMS-based high-volume scalable technology for mobile and IoT: spectral imaging for autonomous systems, smart homes and consumer health

✔ We’re looking for R&D partnerships to develop novel applications: EU projects, partners with HSI data processing and algorithms expertise, end users

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Hyperspectral imaging: Impact through commercialization

Collaboration examples for generating award-winning spectral sensing products

- 2012 Rikola
- 2013 VTT Spin-off
- 2015 Skin Cancer Screening
- 2016 High-volume NIR sensor
- 2018 CubeSat imaging

- 2017 EU food scanner award
- 2018 Three Prism Award Finalists
- 2018 Two Prism Award Winners

Pioneering AI product in health care 2018

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Current offering:
• Radiation and photo detectors
• Tunnel junction and superconductive devices
• Graphene devices and integration
• Thermal devices
• Custom CMOS

On-going & future developments:
• Nano-bolometer detector matrix for thermal IR
• Quantum information systems on-chip
• Nano-phononic filters and sensors
• Megapixel X-ray detector for dental X-ray
• Graphene based bioassays for diagnostics and components for integrated photonics
• 2D material based sensors on flexible platform

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MEMS

Surface micro-machining platform

Piezo platform (AlN, ScAlN)

SOI Platform

Pressure sensor

Ultrasound transmitter or receiver (CMUT)

Ultrasound transmitter/receiver (PMUT)

AE sensor

Acceleration

Micro mirrors

Manufacturing Platform

Sensor

Application

Barometric pressure
Inertial navigation
Height detection
Differential pressure
Flow sensor
Liquid level detection

Flow sensor
NDT testing
Near field communication
Cylinder pressure sensor
Imaging
Proximity sensing
Gesture based user interface
3D positioning

Machine diagnostics
NDT testing
Lidar technology
Space communication
Printed Intelligence Is …

- large area high-volume printing to produce systems and sub-systems
- functionality from electronics, biotechnology, chemistry, optics, optoelectronics, etc. integrated as devices and systems
Roll-to-Roll Printed & Hybrid Functionalities

- **Design Freedom, New functionalities and concept architectures by printing**
  - Thin, flexible, light-weight, stretchable, large area, transparent, decorative, interactive

- **Integration**
  - Embedded/hidden, conformal, easy-to-install, reduced volume, easy-to-use

- **Cost-effective production**
  - High-volume Roll-to-Roll manufacturing, disposable, small material usage
Hybrid integration

Manufacturing
- Printing of electrical wiring
- Surface structuring
- Integration of electrical components
- Overmolding

Collaboration needs
printing materials, process equipment, semiconductors, standardization
Optical Sensors and Instruments
> 30 Years Experience to Develop and Deliver Optical Measurement Solutions

KEY COMPETENCES
- Innovation of Optical Measurement Methods and Systems
- System and Concept Design for Demanding Applications
- Optics, Sensor and Instrument Development from Idea to Pre-commercial Prototypes

CUSTOMERS
- Process and Manufacturing Industry
- Pharma, Agriculture, Food, Military
- Equipment Suppliers

FUTURE DEVELOPMENT EXAMPLES
- Low-cost Hyperspectral Imaging Applications
- Cloud Based Sensor Networks
- Hand-held, Miniature Devices
**Time-gate Raman system**

Collaboration needs
- Single-photon detector arrays, high-power ps lasers