



Low-vibration and drift miniature cryogenic stage for Cryo-EM applications







- Over 600 employees
- System supplier R&D Production
- 5 locations (Enschede (HQ), Best, Delft, Groningen, Munster)
- ISO 9001 & ISO 13485
- World-wide client portfolio

Competences include:

- **Mechatronics**
 - Mechanics
 - Software
 - Electronics
- Thermal management
 - Including cryogenics
- Optics

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- Modelling: FEM / LEM /CFD
 - Thermal, flow, structural & electromagnetism
- **Prototyping and Production**

Example projects High tech – Medical - Industrial







Philips / QSIL

Océ

Lumileds



FEI











Finapres



D.O.R.C.

Content

- Little bit of application background
- SEM/FM/FIB process
- Cryocooler design and analyses
- First verification measurement, work in progress



Cryo EM – Structural Biology Cryogenic Electron Microscopy Background

- Structural analyses of bio-samples (proteins) using EM
- Cryogenic fixation of the samples
 - stopping all motion and metabolic activity and preserving the internal structure by freezing all fluid phases solid







"Cryo-EM has quickly become one of the most important techniques used by structural biologists today to obtain molecular-scale 3D information about protein structures."

Prof. Sir Mark Welland, director of the Nanoscience Centre















Workflow simplification Current Workflow



Many steps – Many risks – Low(er) Yield



Workflow simplification New Workflow



Less steps – Less risks – Higher Yield



Combined Cryo SEM/FM/FIB Visualization, Localization & Machining





All under cryogenic conditions!



Combined Cryo SEM/FM/FIB Demand for zero vibration/drift cryocooler



Main cold-stage requirements:

- Drift < 3 nm min-1</p>
- Vibration < 1nm p2p @ 200Hz</p>
- 6 DOF
- $T_{sample} \le 108$ Kelvin @ $P_{net} = 5$ mW
- Very low volume budget





Combined Cryo SEM/FM/FIB

Demcon kryoz micro cryocooling technology

- Typical outer dimensions: 60 x 9 x 0,72 mm
- Typical cooling area dimensions: 9 x 10 mm
- Max net cooling power: ≈ 200 mW
- Min. temperature : ≈ 75 K

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Gas supply from pressure bottle







Combined Cryo SEM/FM/FIB Cold-stage design











Combined Cryo SEM/FM/FIB Cold-stage integration and first measurements





Combined Cryo SEM/FM/FIB Cold-stage integration and first measurements





Thermal Cold-stage verification measurements



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Thermal Cold-stage verification measurements









Mechanical Cold-stage verification measurements

• Currently in progress....









Questions?

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Cryogenic Heat and Mass Transfer Conference – Universiteit Twente – 5 November 2019