

# 3D – TEM Tomography

## An Evaluation of Commercially Available Systems

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# Motivation

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## **3D-observation in TEM appears promising because of**

- device feature sizes reach conventional TEM specimen thickness
- device features have 3D functionality
- 3D tomographical contrast at highest resolution sounds feasible

Never stop thinking

# Scope of Studies

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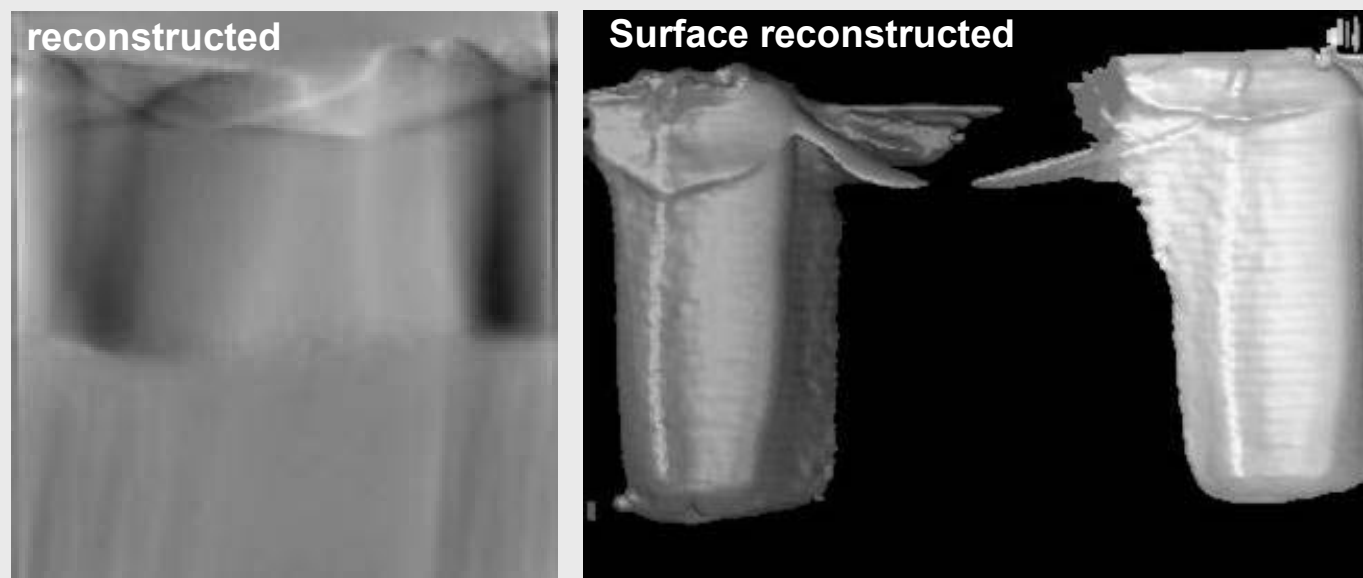
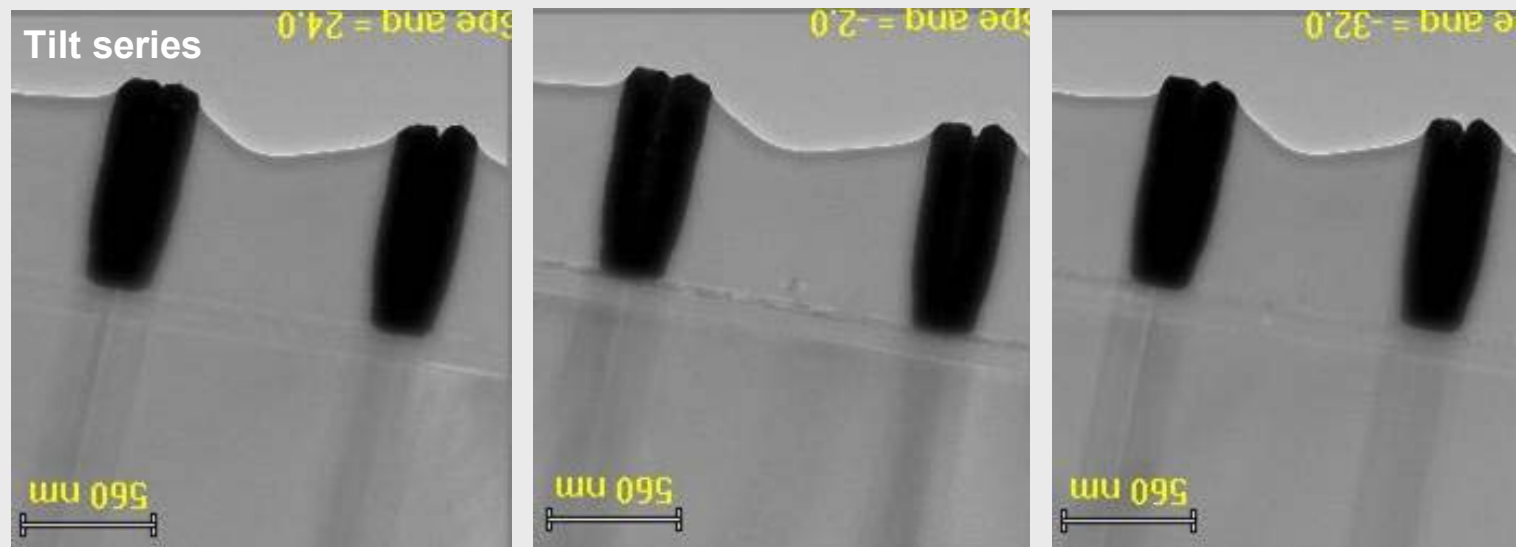
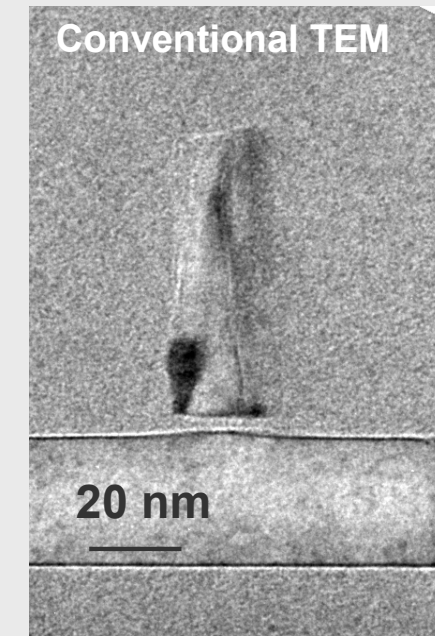
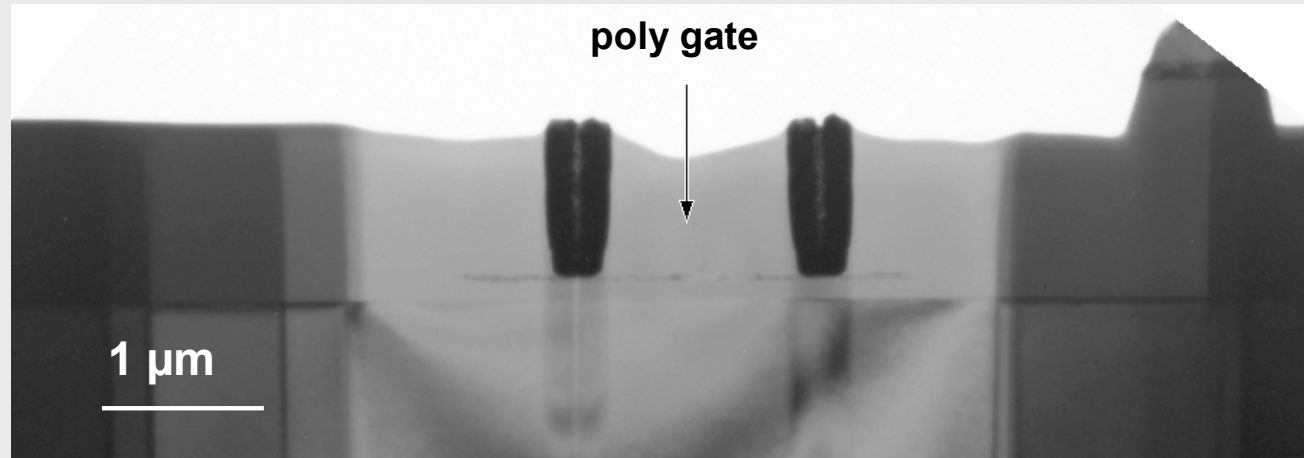
## Tomography Systems available

- Acquisition and Reconstruction SW fully embedded into Tecnai Sphera
- TVIPS- SW and Fischione tomography holder: Price € 40 - 45.000.-
- Gatan-Emispec SW and Gatan tomography holder: Price € 45.000.-

## Tests on two specimens performed at TVIPS Co.

- Use small device features (gate, contact trench) for test at vendor site
- Find out how straightforward the method can be applied and how easily beneficial conclusions can be drawn from the images.
- smallest poly-gate on SOI, missing reference structures for XCF
- small interconnects, deformation of sample due to too high electron dose

# 1<sup>st</sup> Sample: Poly-Gate on SOI



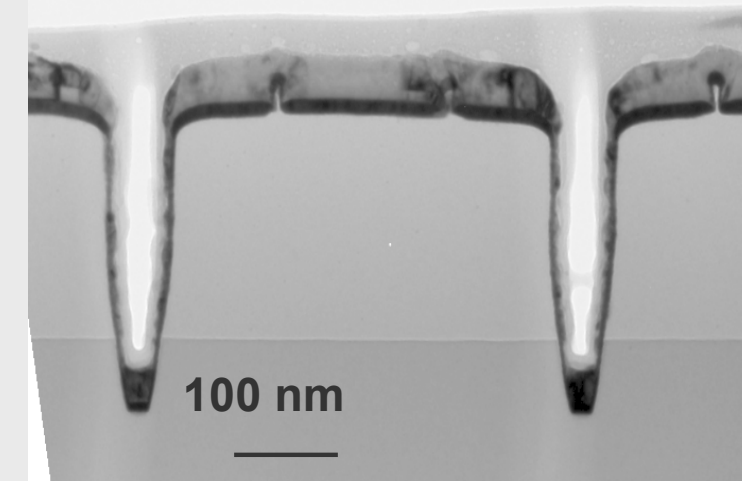
**Problem:**  
 for higher magnifications a reference area with a tilt independent contrast is necessary. The poly-Si grain changes the contrast due to dynamical contrast and the surrounding amorphous materials with their homogeneous contrast are not suited for cross-correlations.

# 2<sup>nd</sup> Sample: interconnect (liner only)

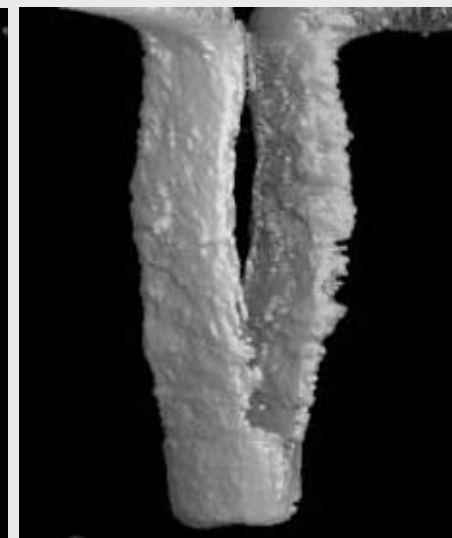
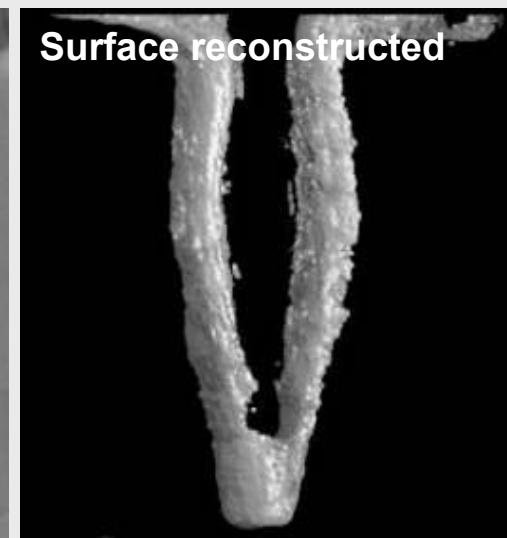
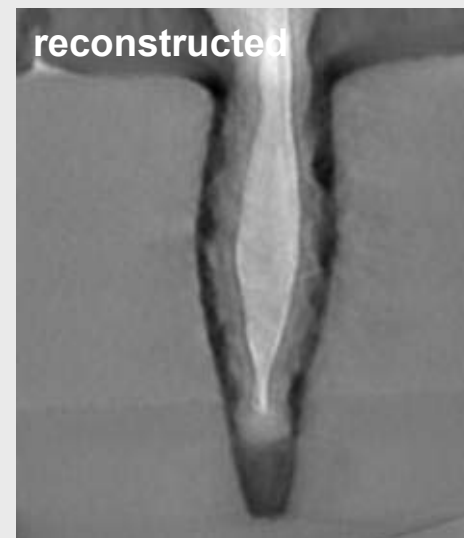
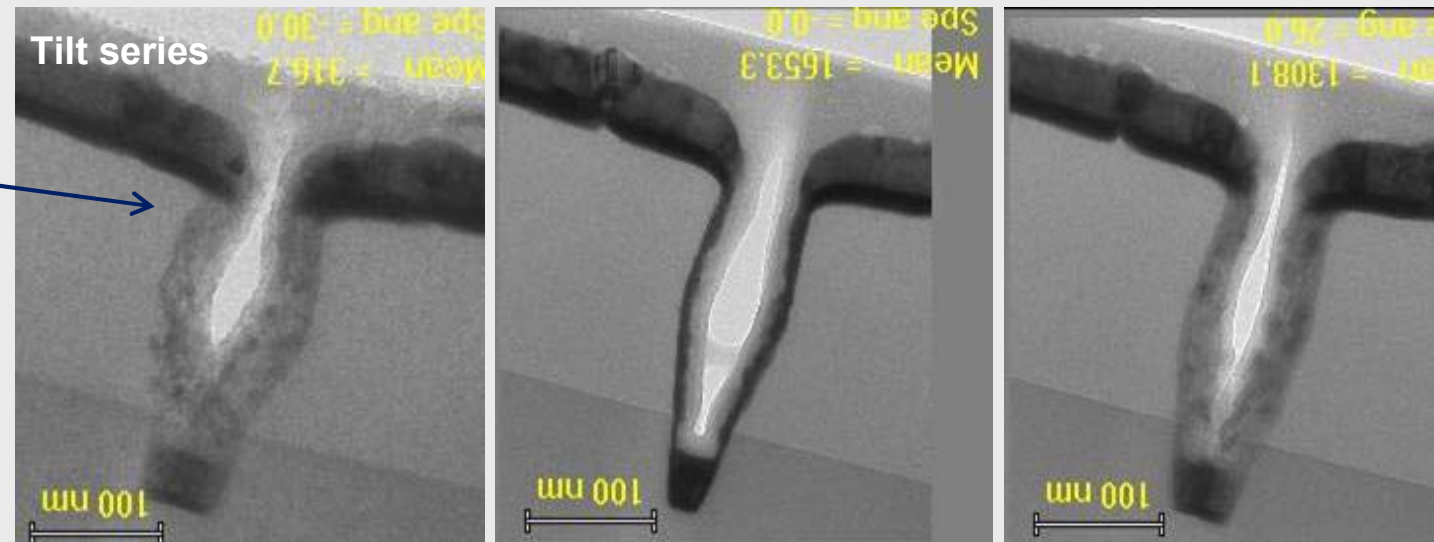
**Problem:**

In order to avoid deformation, tomography experiments should be carried out under low electron dose conditions

Conventional TEM



Deformation due to high electron dose



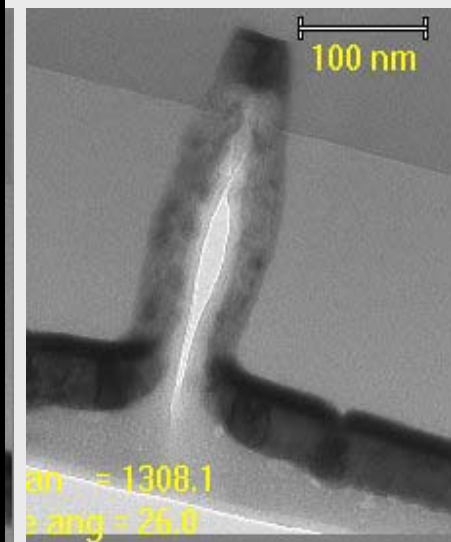
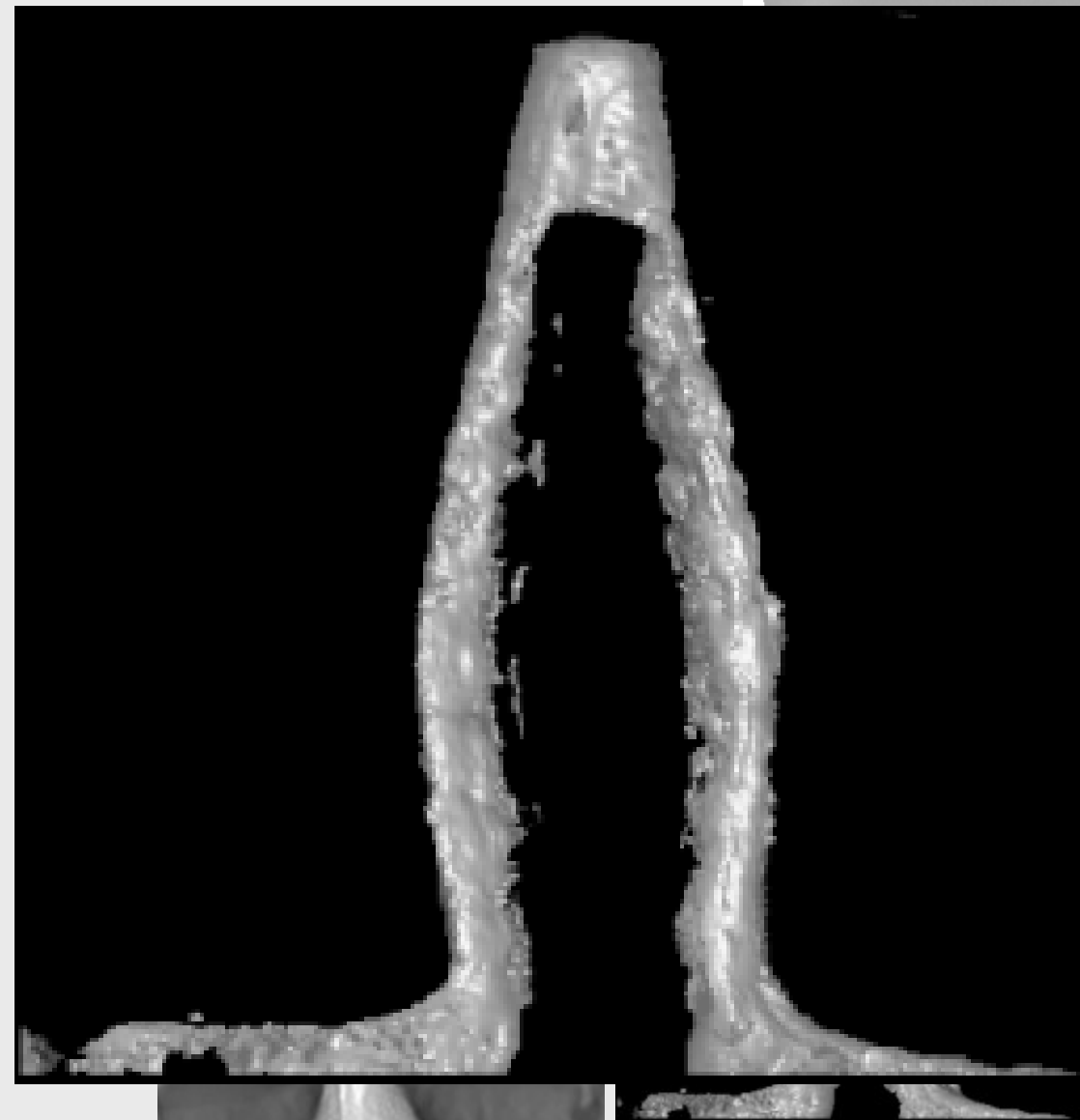
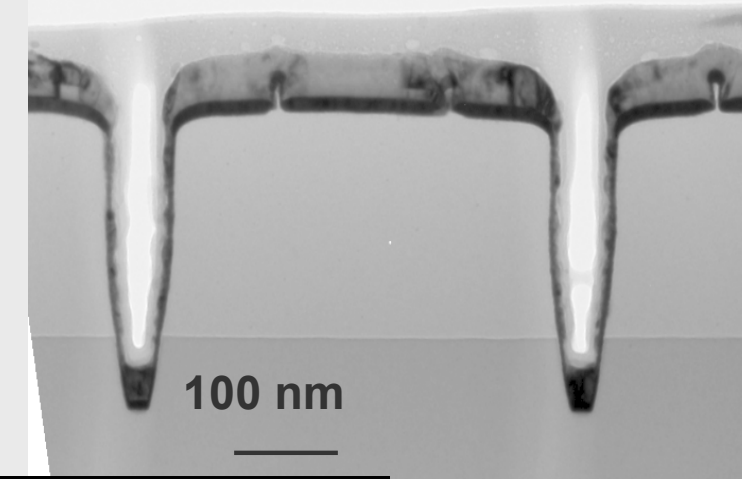
Never stop thinking

# 2<sup>nd</sup> Sample: interconnect (liner only)

Never stop thinking

Movie of surface reconstruction

Conventional TEM



## Most important results

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- Tomographic images of two samples (gate structure and interconnect trench) were recorded at Tietz VIPS Co.
- For high magnifications a reference area with a tilt independent contrast is necessary. Structures with strong dynamic TEM contrast cause the image reconstruction algorithm to fail.
- Experiments have to be carried out at low dose since several adjustments and several tilt series have to be recorded.