Introducing ZEISS Crossbeam FIB-SEM for the nanoscience market

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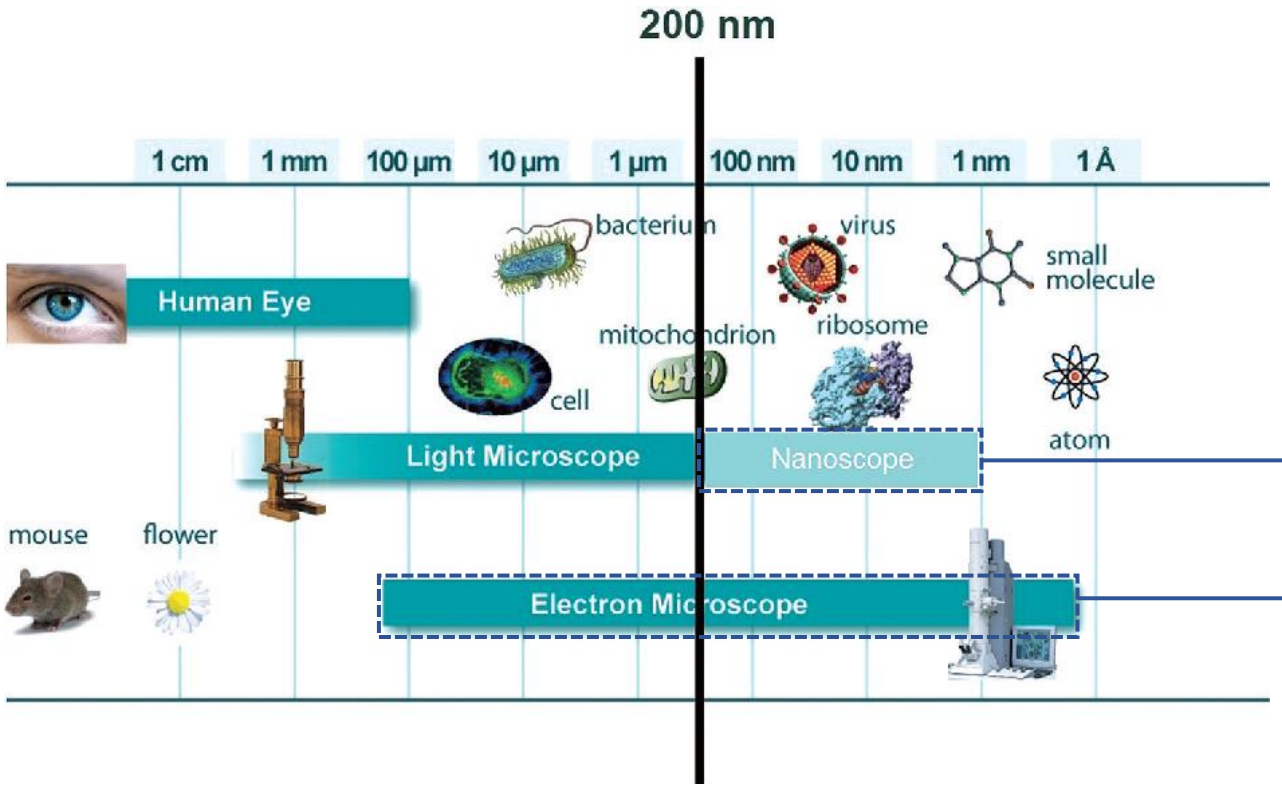
Agenda

- Why Electron Microscopy
- Why FIB-SEM
- Applications and VPs
- Competitors
- SWOT
- Product Market Pyramid Process

A Brand-New World: The need of high resolution

To overcome Abbe's limit, new physical approaches are required: STED - EM



$$D = \frac{\lambda}{2n \sin \alpha} = \frac{\lambda}{2NA}$$

Stefan Hell
STimulation
Emission
Depletion

Ruska & Knoll
Electron
Microscope

Scanning Electron Microscopes produces images with high resolution

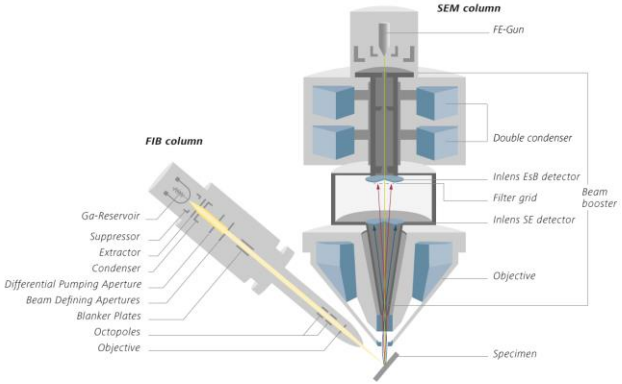
For some applications, materials need to be manipulated for the best image acquisition→ **FIB-SEM (Focused Ion* Beam)**

Advantages	Challenges
Ion beams have much shorter wavelength and so are capable of better resolution (1000x smaller than electron)	Sample charging is likely, control is necessary (Gas injection, e-beam, flood gun).
Ions interact more strongly with all material and so generate more signal	Ion beams will modify and damage surfaces (imaging is destructive)
Ions have a bigger mass and are slower than electrons so the beam is collimated and more material can be removed (sputtering)	
Ions allow high resolution and high depth of field (with electrons is a trade-off)	

*Usually Ga, He, Xe. Helium and Xenon have lower mass than Gallium and this allows for precise and controlled machining. Ga has greater mass that allows for rapid material removal. FIB-SEM Zeiss Crossbeam is based on Ga LMIS (liquid metal ion source).

Meet FIB – SEM – Crossbeam Family

Your FIB-SEM for High Throughput 3D Analysis and Sample Preparation

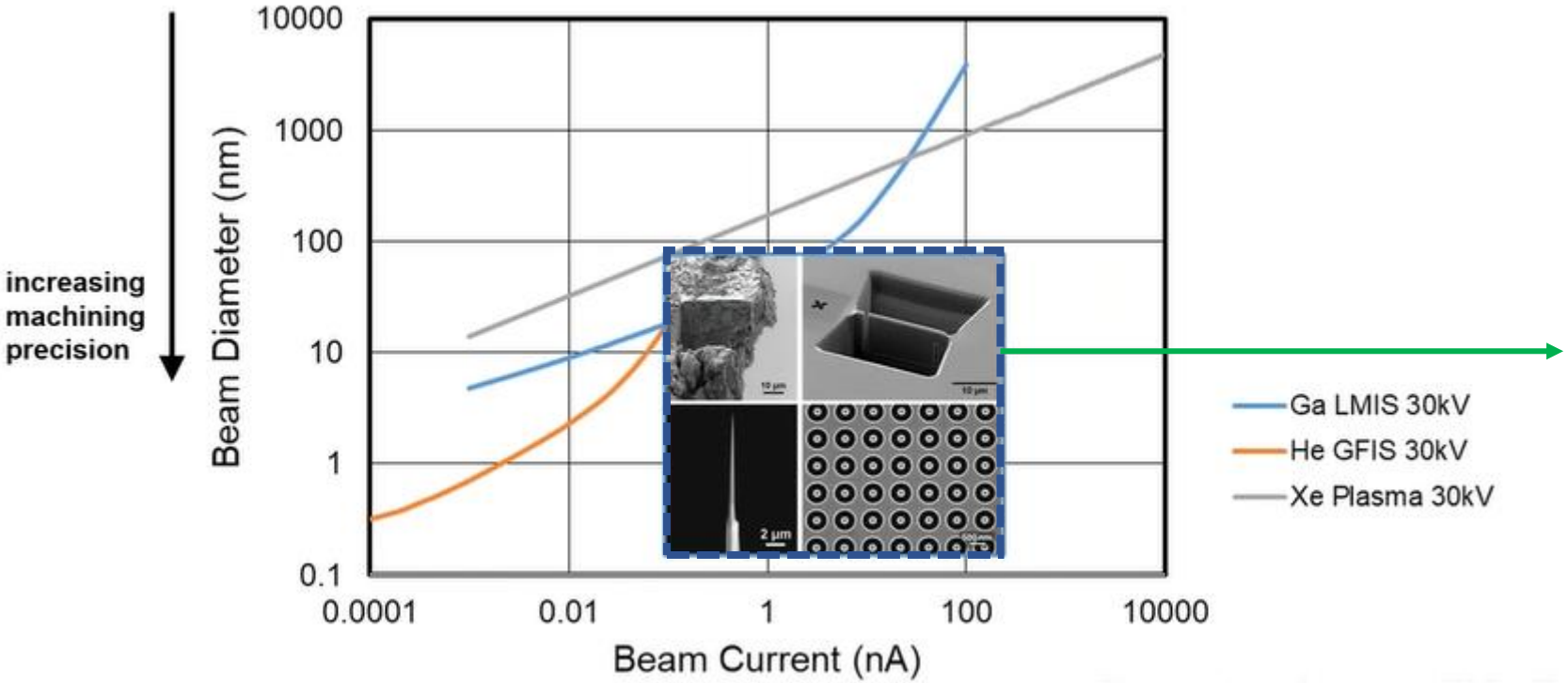


Key Value Propositions

- Combine 3D imaging, analysis and material processing
- Profit from a next-generation FIB when preparing your sample
- Enjoy real-time interaction and perform imaging and milling simultaneously

ZEISS FIB-SEM is very versatile, powering Imaging, Milling, Deposition

Ga LMIS enables best performance, trading-off beam diameter and beam current



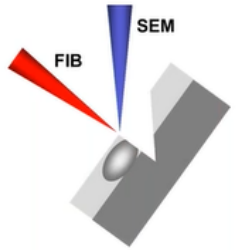
Potential Applications

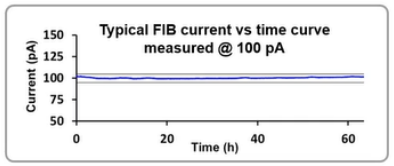
- Tomography
- TEM sample prep
- Atom probe sample preparation
- Nano-patterning
- Serial cross-sectioning & 3D reconstruction

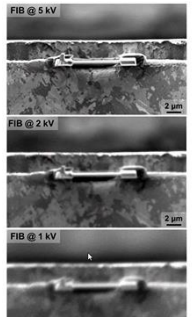
Applications and Value Propositions

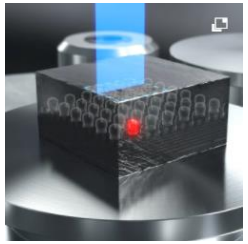
	Tomography	**TEM Sample Prep**	**LaserFIB For New/Enhanced Application**
Description	• Mill VOI slice by slice using the FIB • Image cross-section face with SEM	To prepare thin enough sample cuttings from bulk materials	Combining FIB-SEM with femtosecond laser to access buried regions of interests or cantilever production
Need	Gain the **most accurate possible 3D representation** of the VOI (volume of interest) for precise critical dimension measurement of complex non-planar structure	Manipulate the material to have the **most precise lamella to be analyzed**, using a very stable source. Easy to use since it is lab routine. Minimize amorphization to get the best TEM	**Heat Affected Zone (HAZ)** jeopardized the material and the image analysis. Material removal sometimes too slow for routine processes

Value Proposition	• Combine analytic techniques with other **multi modal** multi scale data
	• Acquire tomograms having a measure of each of the slice→ **Slice thickness control**
	• **Stable** slice thickness (e.g. 3nm) to reconstruct the sample
	• **Algorithm** to avoid artefact → thin and fast technique
		• Very **stable FIB current** in time
		• Great l**ow kV performance** to minimize amorphization
		• Fast sample preparation with well established routine from ROI to lamella manipulation (Flip and hold)
		• ZEN core EM software with **improved User experience**
		  • More automation
		  • Option for guided workflow
		  • Integrated Manipulator control
		  • Full control during lamella thinning
			• Dual chamber approach - Material removal takes place outside of the main FIB-SEM chamber (**no system contamination**)
			• Femtosecond laser processing of materials can be performed simultaneously to work being done in the main chamber, thus **increasing system productivity**
			• **Fast material removal rates** are not strong functions of material hardness, making the technique applicable to cutting edge materials systems such as ceramics, thermal barrier coatings and nuclear materials.









Crowded competitive landscape

ZEISS can leverage premium products and trusted brand

Competitor	Description
JEOL	**JIB-4000PLUS** • Very close to ZEISS's in terms of features and applications
HITACHI	**FIB-SEM NX9000 series** • The combination of high-brightness cold-field-emission electron source and high-sensitivity optics support analysis of a wide range of materials from biological tissues to magnetic materials
ThermoFisher SCIENTIFIC	**DualBeam line** • Very close to ZEISS's in terms of feature and applications • 4 different Ion species
TESCAN	Very early-stage company
Leica MICROSYSTEMS	**Modular System level** (e.g. Ion Beam Milling System + Leica EM TXP + …) • Sample prep focused on biological and medical samples (positive for COVID-19 market traction?) • Indirect Competitor

SWOT Analysis

Brand awareness with high quality products in addition to digital innovation will help maintaining a healthy business

Strengths

- Premium Microscopy Products
- Brand Trust and Awareness
- Strong relation with suppliers and existing customers
- Innovation, R&D oriented
- Customer satisfaction[1]

Weaknesses

- HQ in less attractive geographical position[2]
- Long sales cycle, non-repetitive sale

Opportunities

- Digital transformation with AI implementation and machine learning[5]
- Adding new feature for new applications (e.g. LaserFIB)
- Exploit COVID-19 market traction

Threats

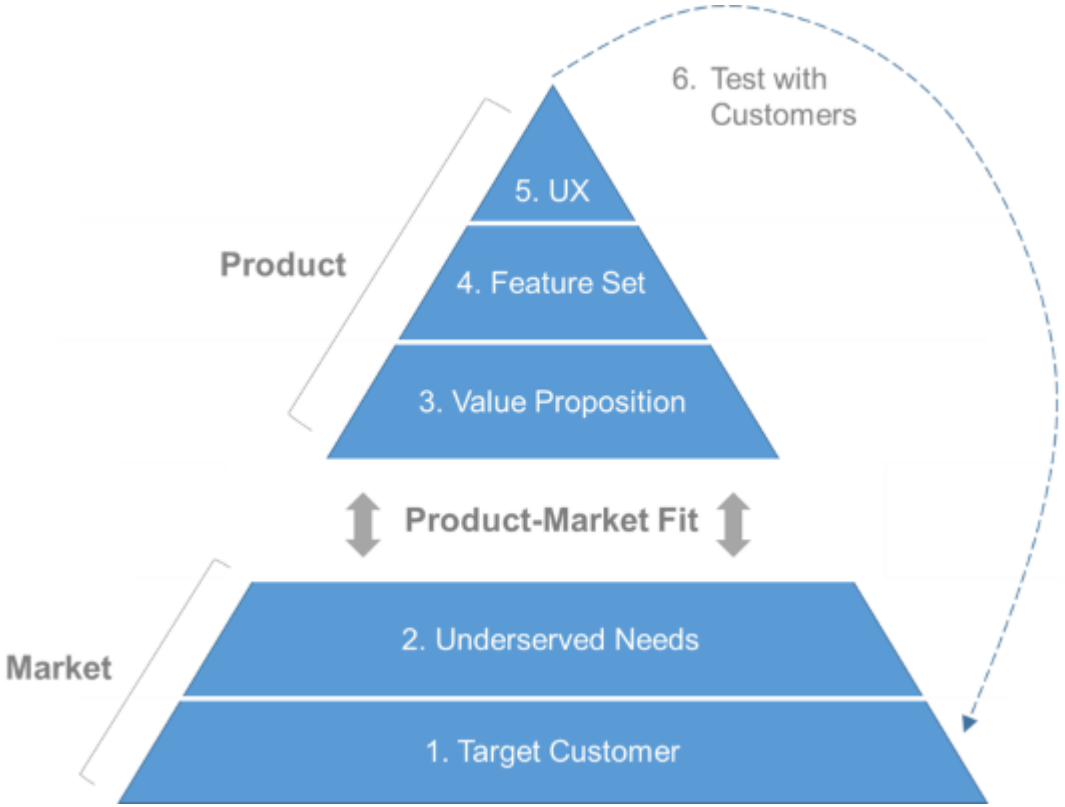
- Government regulations and bureaucracy
- Increasing components cost (e.g. chip shortage)[3]
- New companies can move fast with less margin[4]

Sources:

- [1]https://www.cambridge.org/core/journals/microscopy-and-microanalysis/article/using-iot-to-improve-uptime-and-customer-satisfaction/350F509D08459517C7EB6861A17EFB4D
- [2]Glassdoor, Indeed
- [3]https://www.bbc.com/news/business-58230388
- [4]https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-to-move-fast-innovation-at-speed-and-scale
- [5]https://blogs.zeiss.com/microscopy/en/tag/correlative-microscopy/

The Product Market Pyramid Identifies the Product-Market fit process

A proven lean approach to bring new products to the market



Target Customer

- Check existing customer
- Interview KOL
- Talk to Marketing, R&D, PMs
- Firmographic Segmentation

Define underserved needs to develop VPs

- Usually, universities needs different from industry ones
- Are the customers happy with existing solution to the problem?
- Do competitors appear to be successful in delivering these solutions?
- Is the price that competitors charge appropriate?
- What new benefits would your product deliver? (Aside from being cheaper)

Value Proposition Iteration

- USP definition
- Urgency of need
- Worth to customer
- Market size
- Competition
- Time to Market