2016年FEI全国用户会议汇报

2016 年 8 月 17 日~8 月 21 日

西　安

周巧琴　2016.10.12


CROWNE PLAZA
XI'AN
西安皇冠假日酒店
FEI™
FEI
全国用户技术交流会
WELCOME
西安 2016


热烈欢迎广大客户参加
FEI全国用户技术交流会
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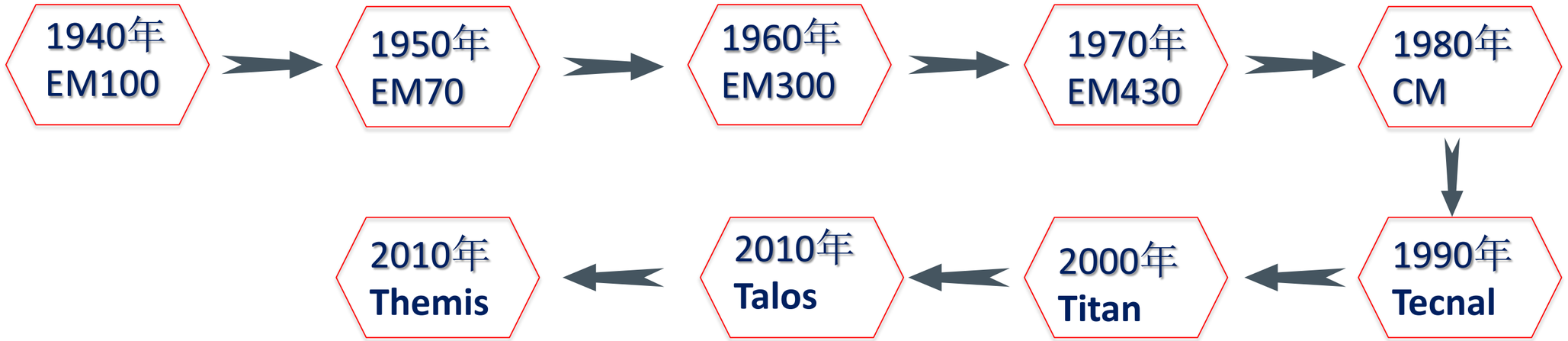
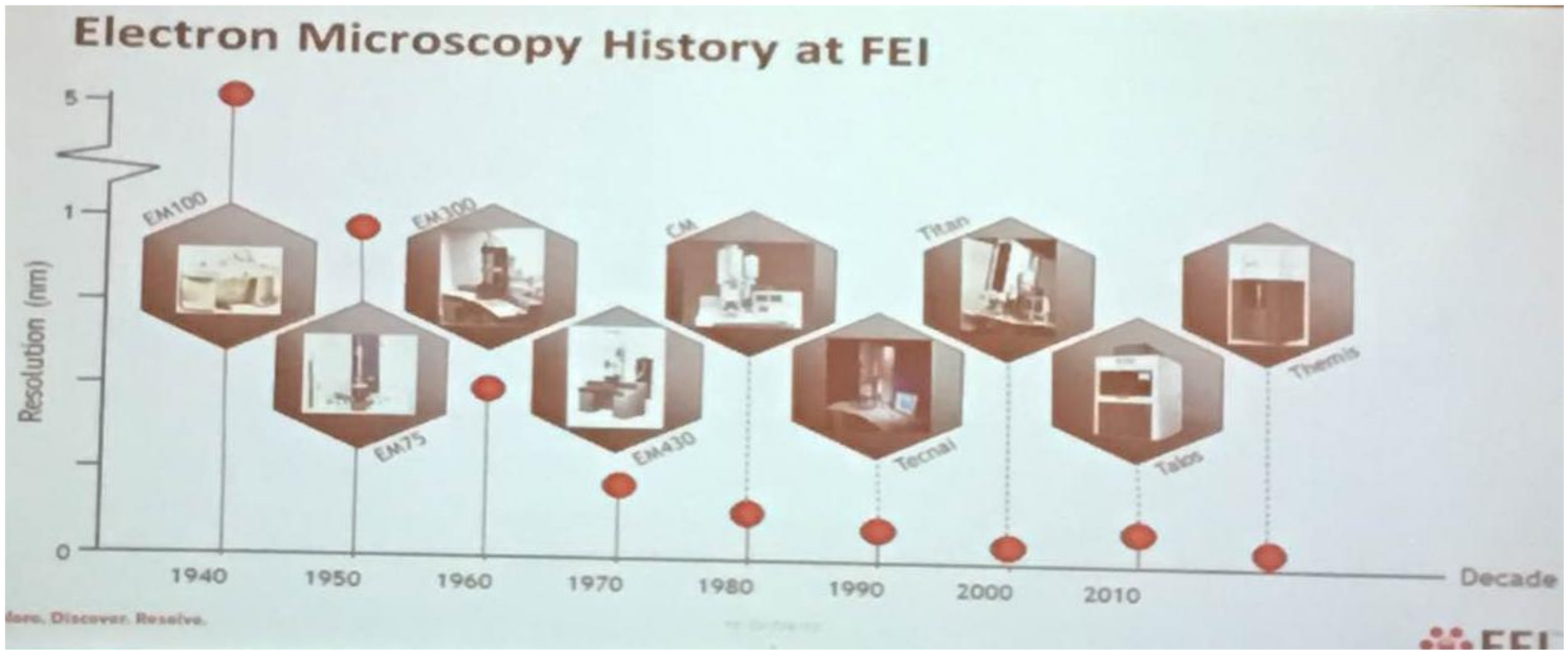
2016年FEI全国用户技术交流会
2016.8.18 西安

一、Recent TEM Technology Developments

TEM的发展


1940年
EM100
1950年
EM70
1960年
EM300
1970年
EM430
1980年
CM
1990年
Tecnal
2000年
Titan
2010年
Talos
2010年
Themis


Electron Microscopy History at FEI
Resolution (nm)
5
1
0
EM100
EM75
EM300
EM430
CM
Tecnal
Titan
Talos
Themis
1940
1950
1960
1970
1980
1990
2000
2010
Decade
Explore. Discover. Resolve.

TEM Techniques General Overview

TEM

Imaging (*with camera)

- Normal TEM
- Bright Field (BF)
- Dark Field (DF) / WBDF
- HRTEM
- Lorentz TEM
- Holography

Chemical

- Point EDS /Area EDS (focus or spread beam)
- Point EELS / Area EELS (focus or spread beam)
- EFTEM

3D info

- TEM Tomography

Diffraction/in-situ

Diffraction

- SAED
- NBD
- CBED
- LACBED
- ——

In-situ

- Heating
- Cooling
- Press/Tensile
- Current
- Gas
- Liquid
- Light
- ——

(*short in TEM mode)

STEM

Imaging (*with detectors)

- Bright Field BF
- Annular Bright Field (ABF)
- Annular Dark Field (ADF)
- HAADF
- DPC (dDPC/ iDPC)

*HR-STEM / LM-STEM

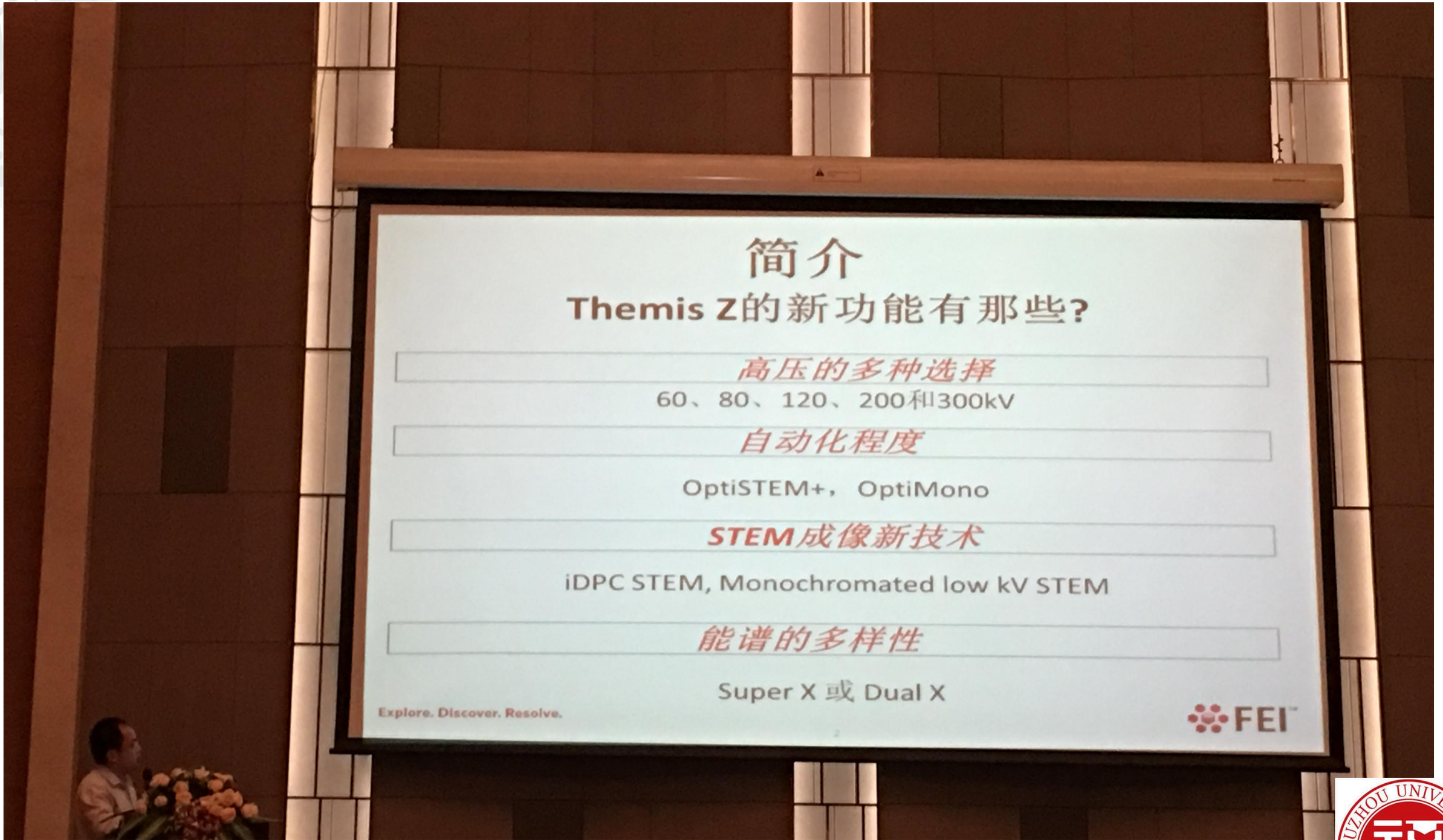
Chemical

- STEM EDS (point/line/map)
- STEM EELS (point/line/map)

3D info

- STEM Tomography
- EDS Tomography

二、FEI 新一代球差校正（扫描）透射电镜
—Themis Z


简介
Themis Z的新功能有那些?
高压的多种选择
60、80、120、200和300kV
自动化程度
OptiSTEM+， OptiMono
STEM成像新技术
iDPC STEM, Monochromated low kV STEM
能谱的多样性
Super X 或 Dual X
Explore. Discover. Resolve.
FEI

三、超高分辨扫描电镜Verios™ 460

Verios™ 460

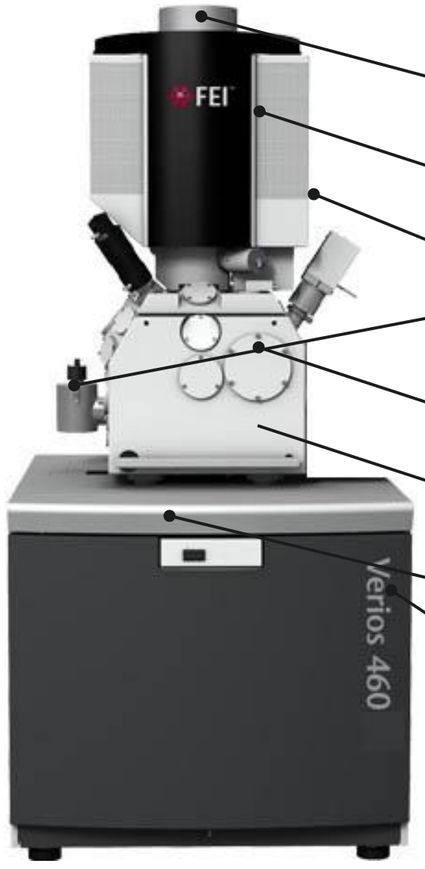
Extreme high resolution imaging

Precise contrast

High resolution analysis

Explore. Discover. Resolve.

FEI Verios 460: Uncompromised Technologies



Unique Technology
Schottky-UC, Hot-Swap Gun

Elstar SEM Column + Beam Deceleration

FEI Plasma Cleaner

FEI Cryo Cleaner

Large Analytical Chamber

21 Ports for Detection, Analytics and More

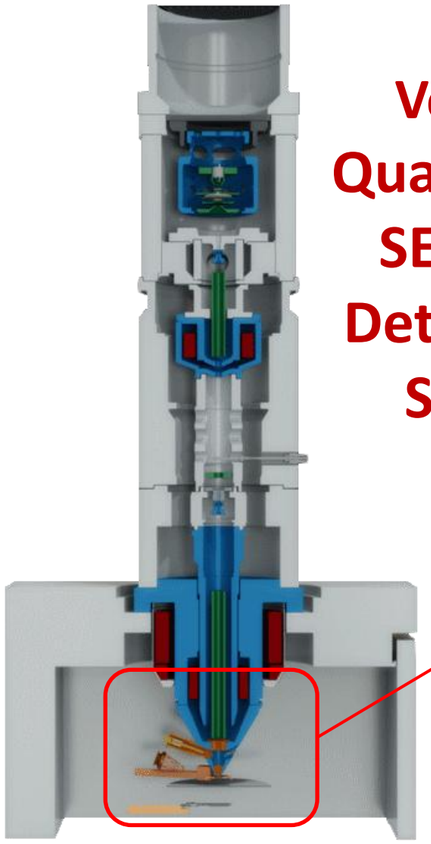
100mm Stage

High Stability Platform

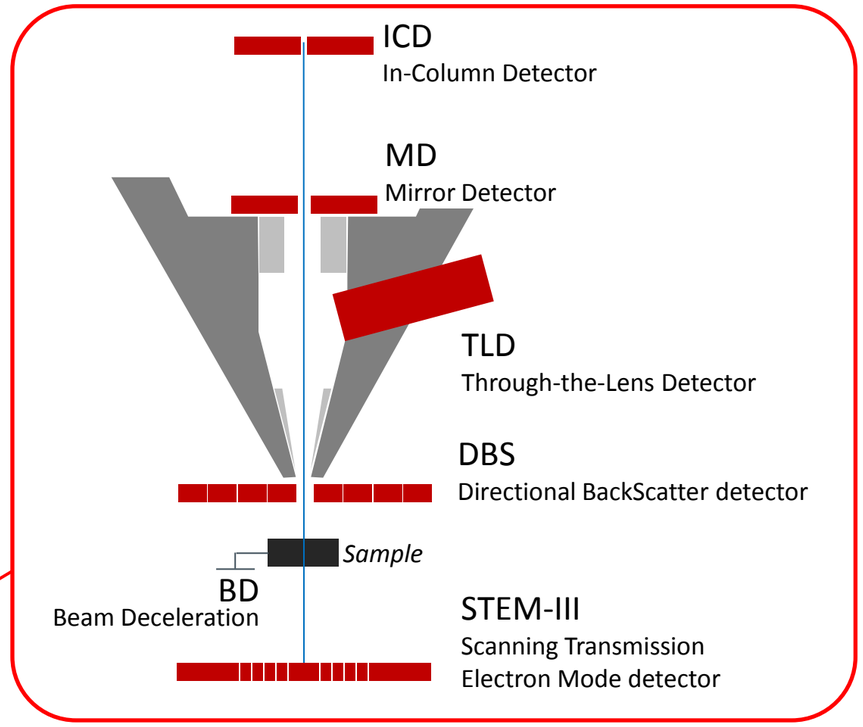
Elstar SEM Column

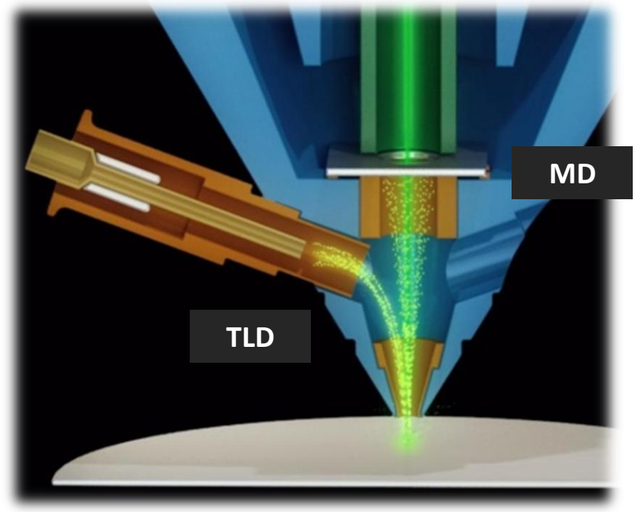
Precise Contrast from SE, BSE and TE

From highly efficient collection & subtle filtering



Verios Quadruple SE/BSE Detection Suite





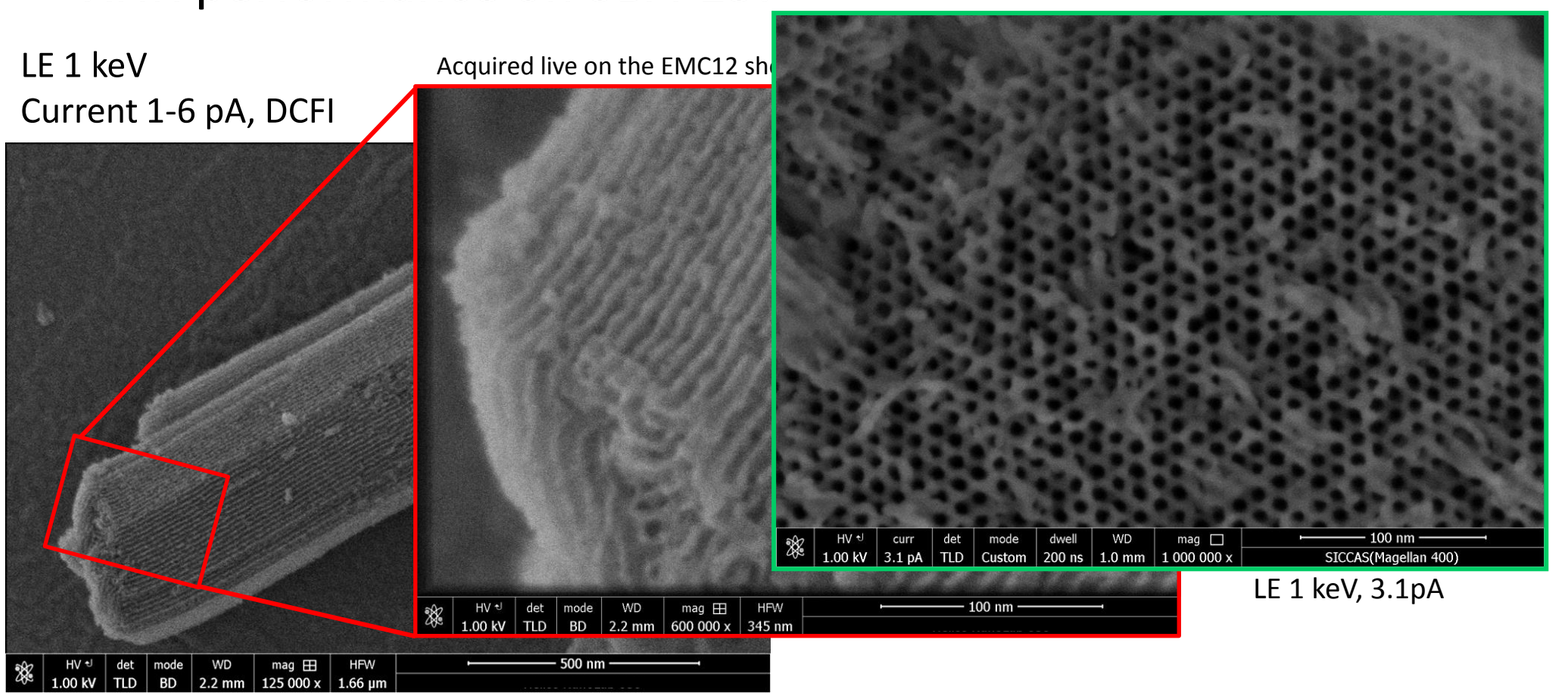
- **High signal collection efficiency**
- **Refined signal filtering by angle and energy**

Revealing the finest details

On beam sensitive, contaminating or non conductive samples

- No beam damage, thanks to low dose (few pA) imaging capability
- Neither drift nor charging, thanks to low kV, advanced imaging modes
- No contamination, thanks to the Verios efficient cleanliness management
- XHR performance on SBA-15:

LE 1 keV
Current 1-6 pA, DCFI

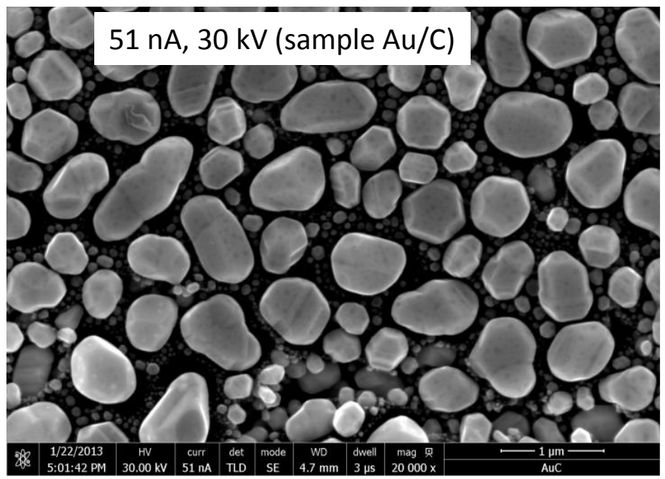


LE 1 keV, 3.1pA

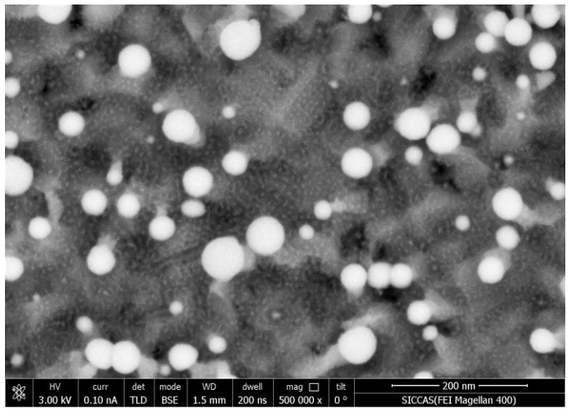
High resolution analysis

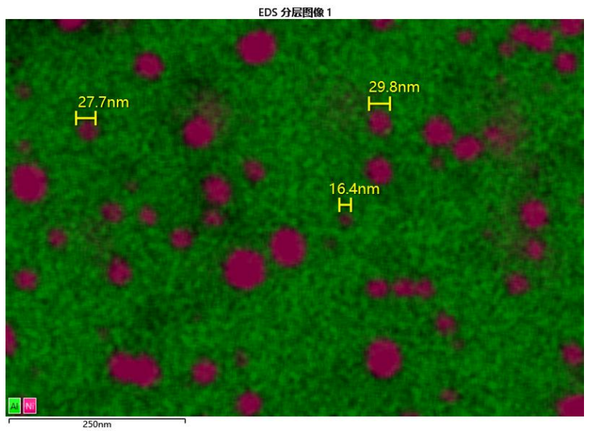
Elstar's uncompromized performance at higher currents

- Fast high resolution analysis
  - Up to 100 nA, even at lower kV
  - Measured resolution @ 15 kV, 6.4 nA, ***analytical WD (4 mm): < 2 nm***



- Highest spatial resolution analysis
  - < 10 nm achievable on thin samples
  - < 20 nm achievable on bulk samples using lower kVs



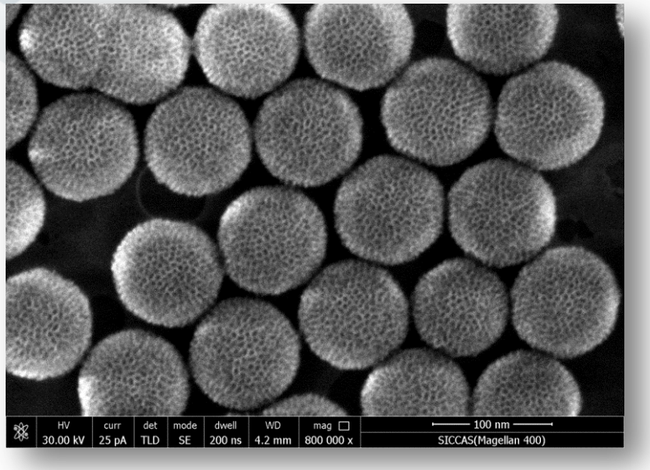


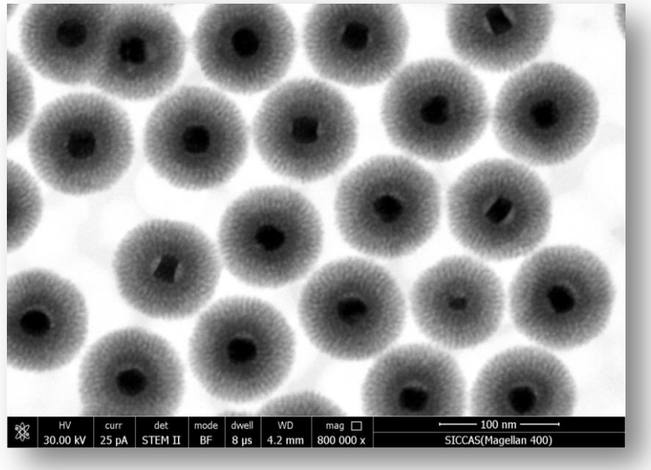
Ni Nano particles on Al_2O_3 Ceramic
(Bulk Sample,3kV HR EDS Mapping, beam current 3.2nA)

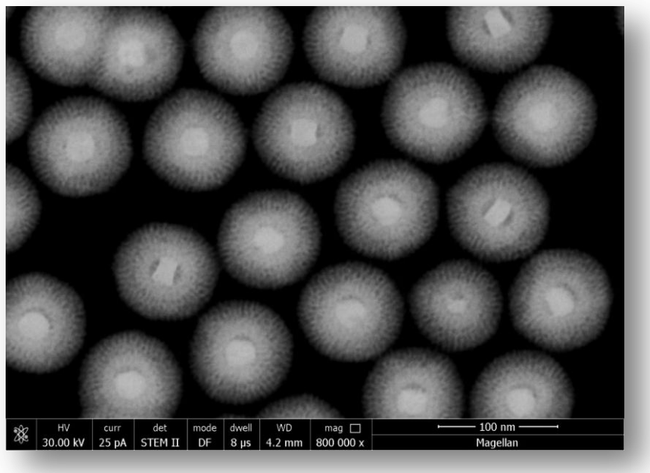
- No hardware change, column realignment or compromised low kV resolution to access Elstar's high current modes

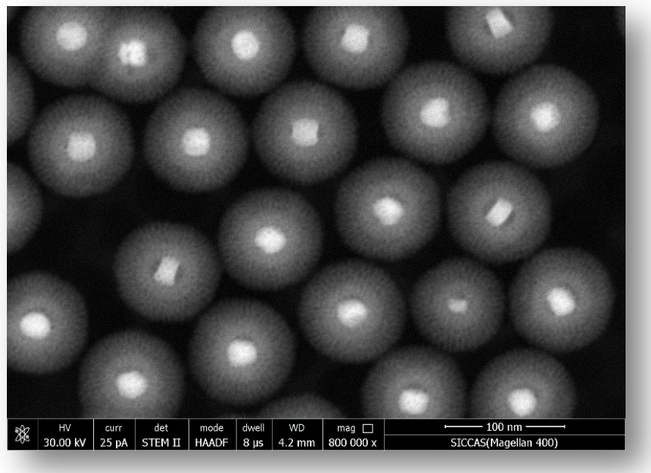
High resolution analysis

Elstar’s uncompromized performance at higher currents

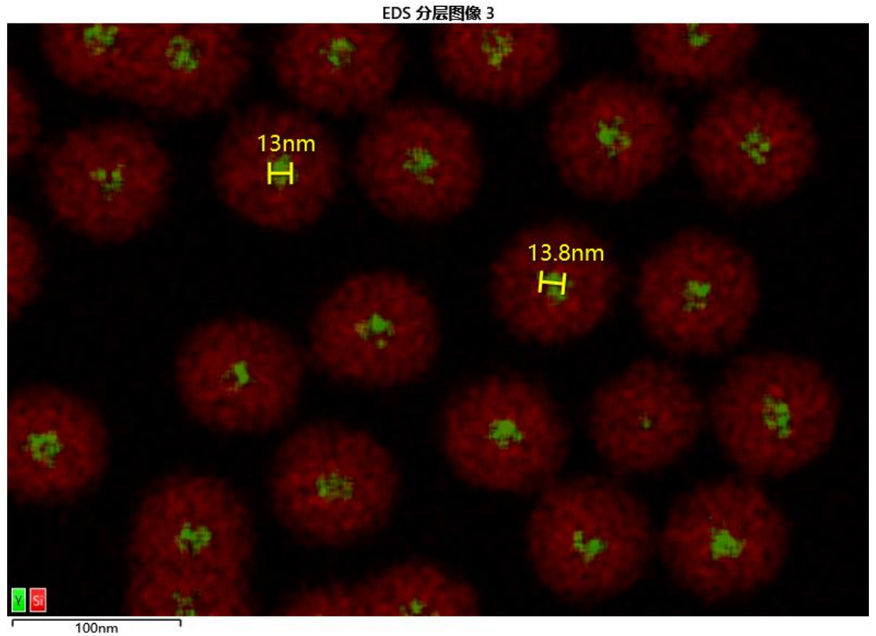








STEM image

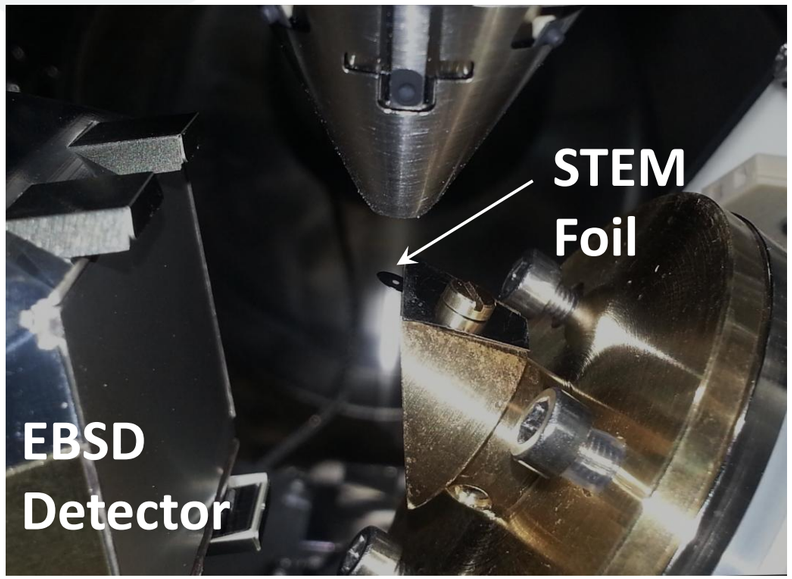


30kV STEM EDS Mapping
(beam current 3.2nA)

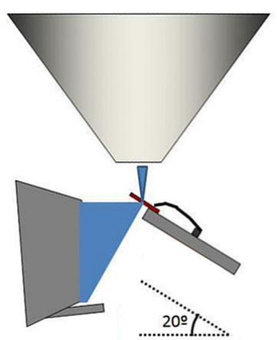
Explore. Discover. Resolve.

High resolution analysis

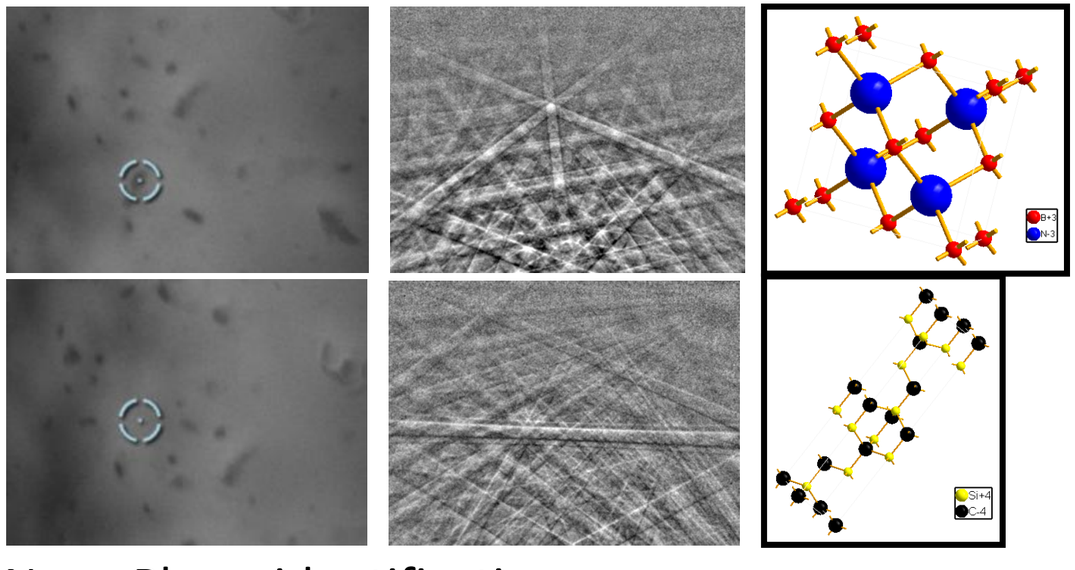
Elstar's uncompromized performance at higher currents



TKD

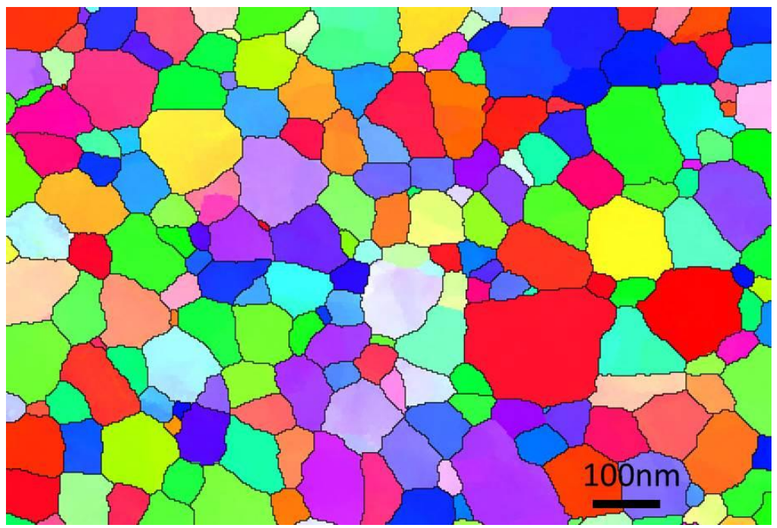


(1)



Nano Phase identification

(2)

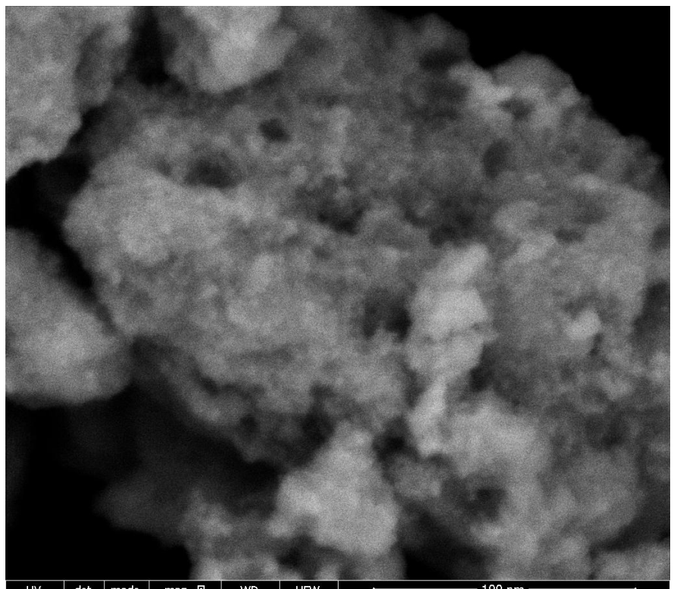


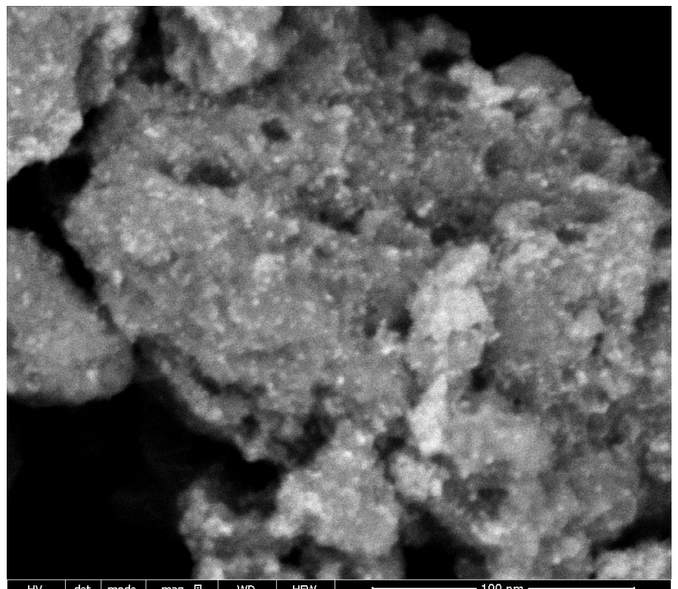
Nano ZrO_2 ceramic

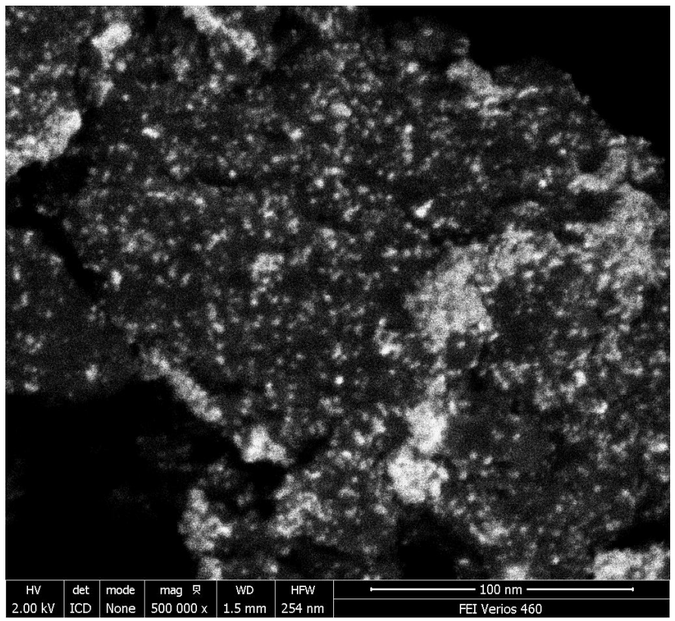
TKD-High spatial resolution EBSD Mapping

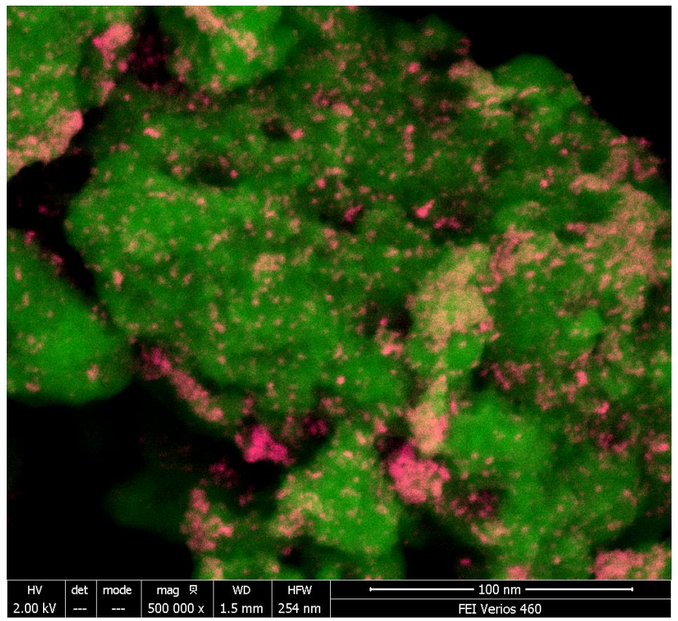
Explore. Discover. Resolve.

Sample1: Pt@CeO









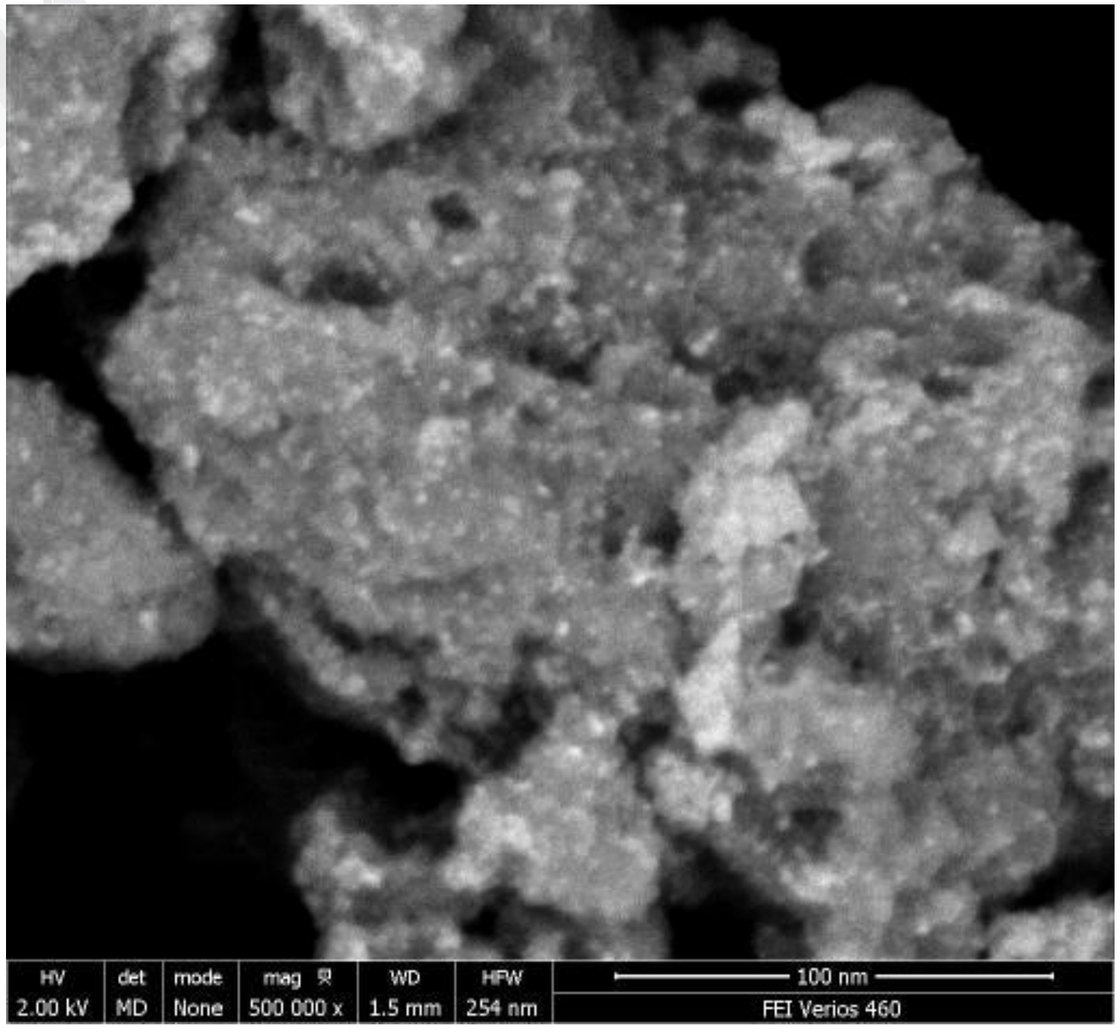
TLD-BSE	MD-BSE
ICD-BSE	MIX

Tool: Verios 460

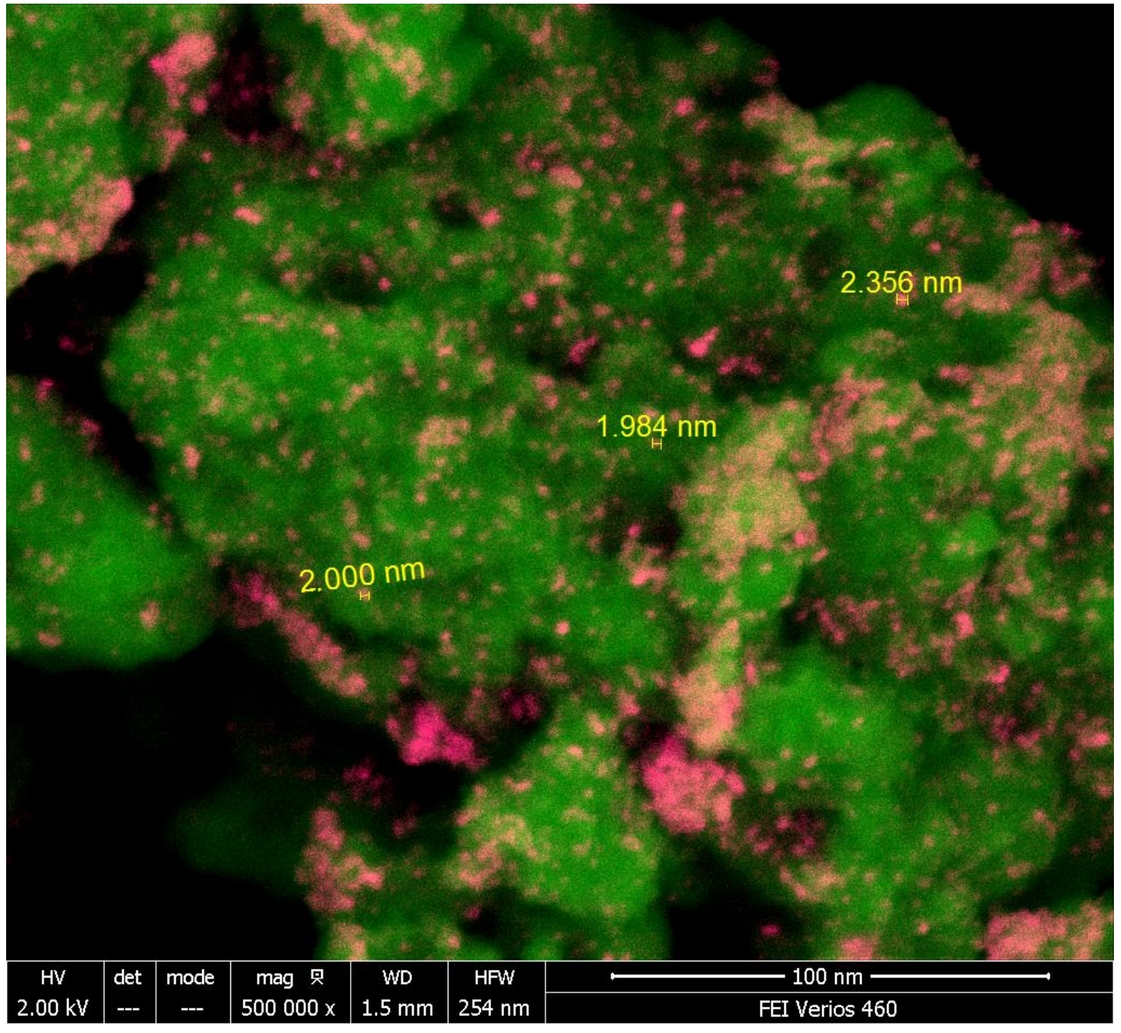
High Voltage: 2kV

Magnification: ×500k

Sample1: Pt@CeO



MD-BSE

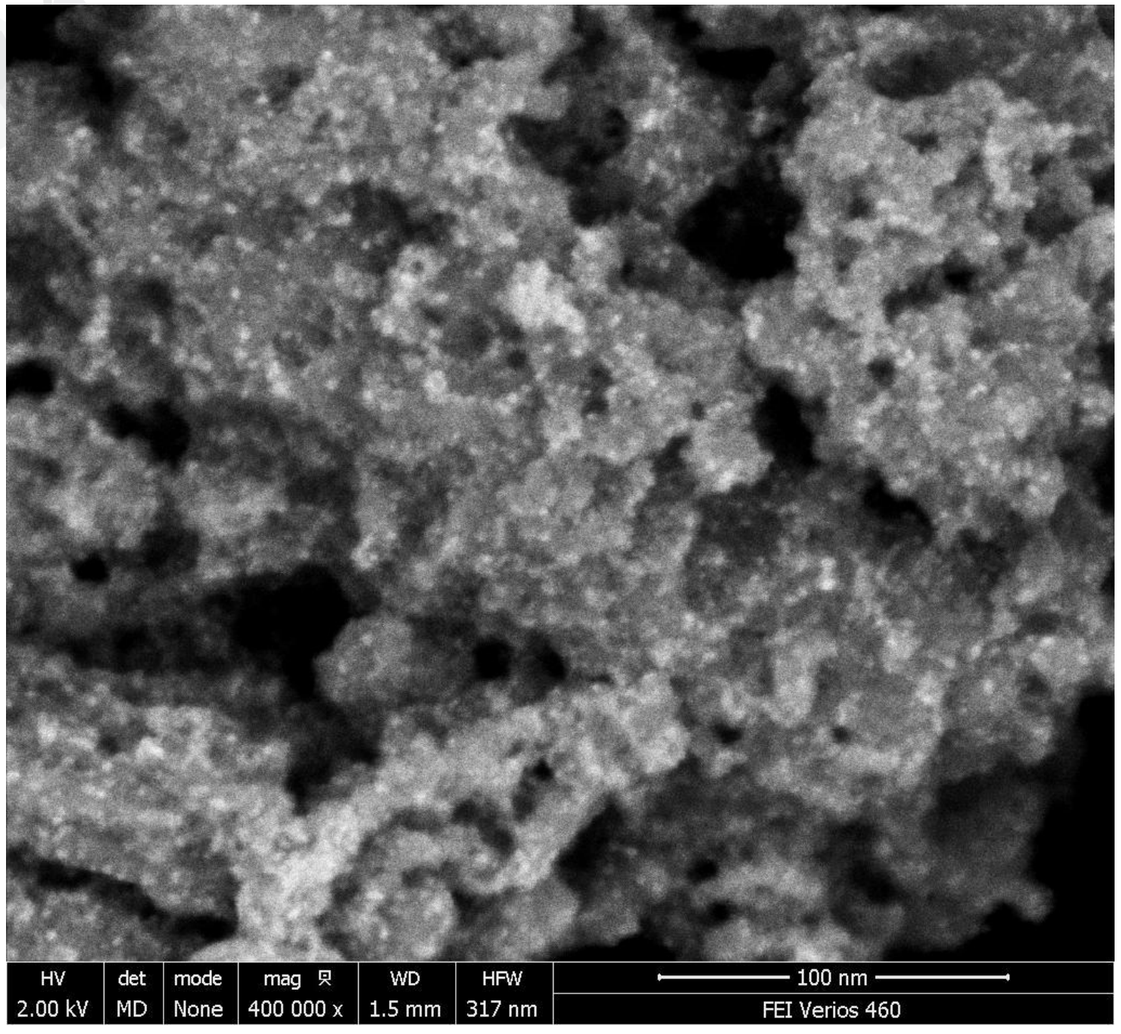


Mix

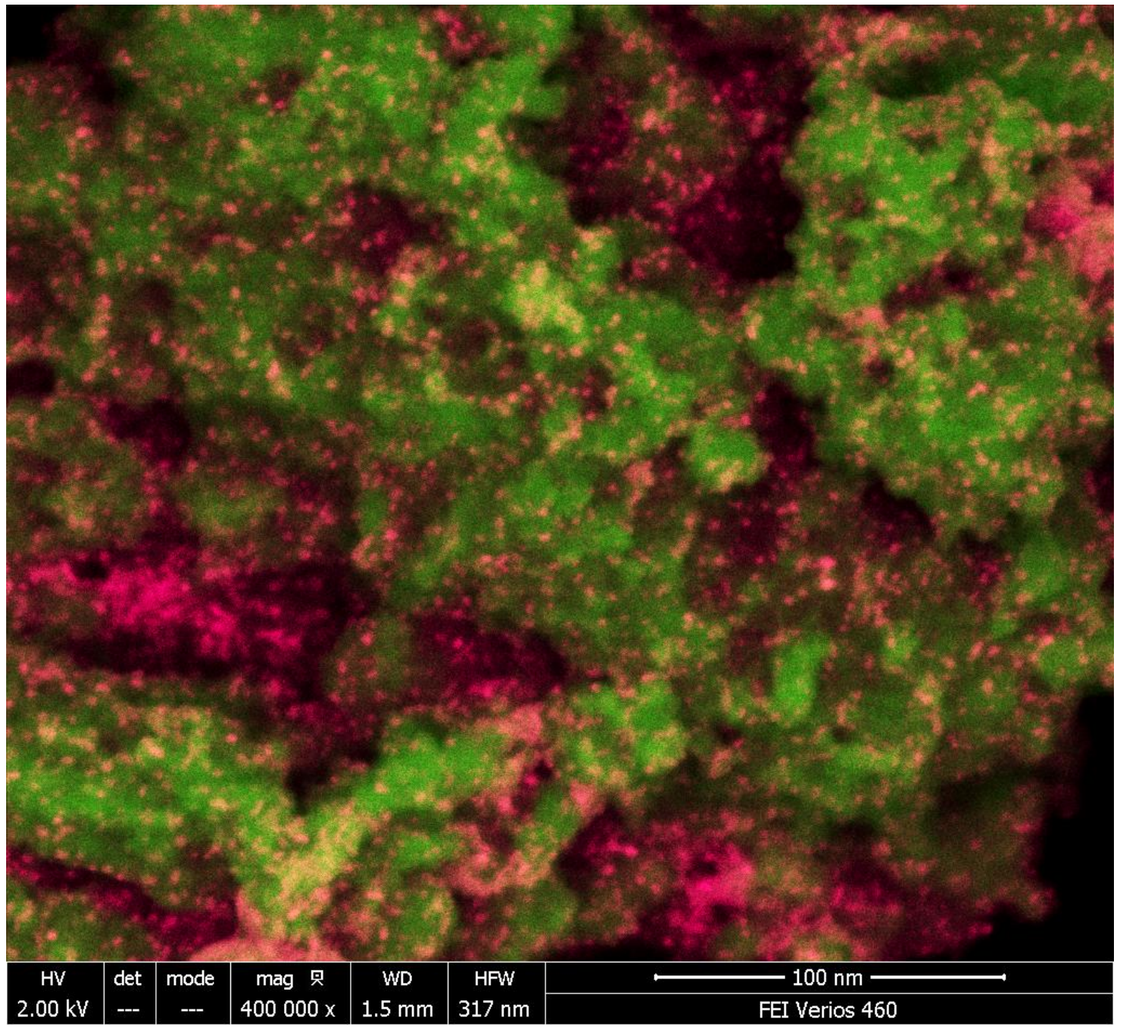
High Voltage: 2kV

Magnification: ×500k

Sample1: Pt@CeO



MD-BSE

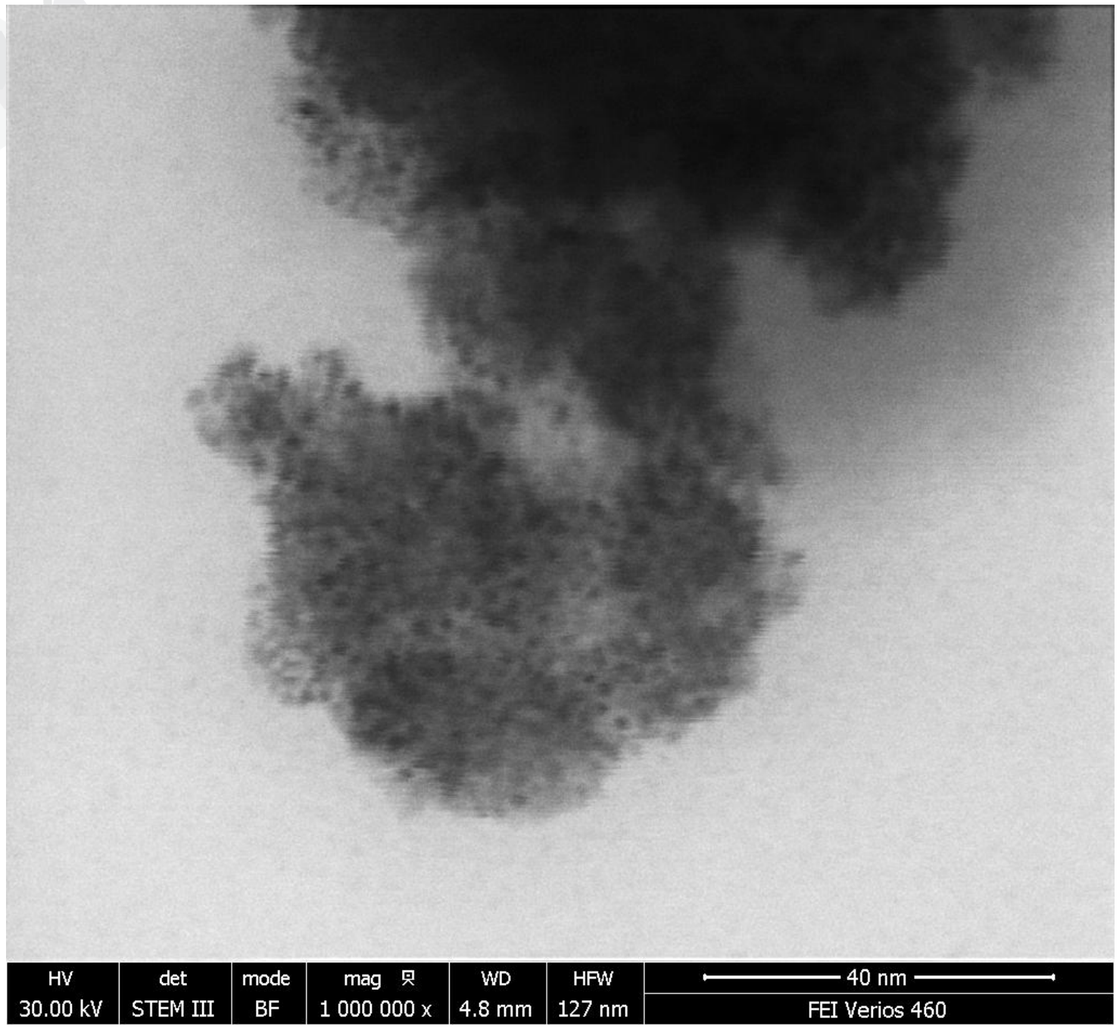


Mix

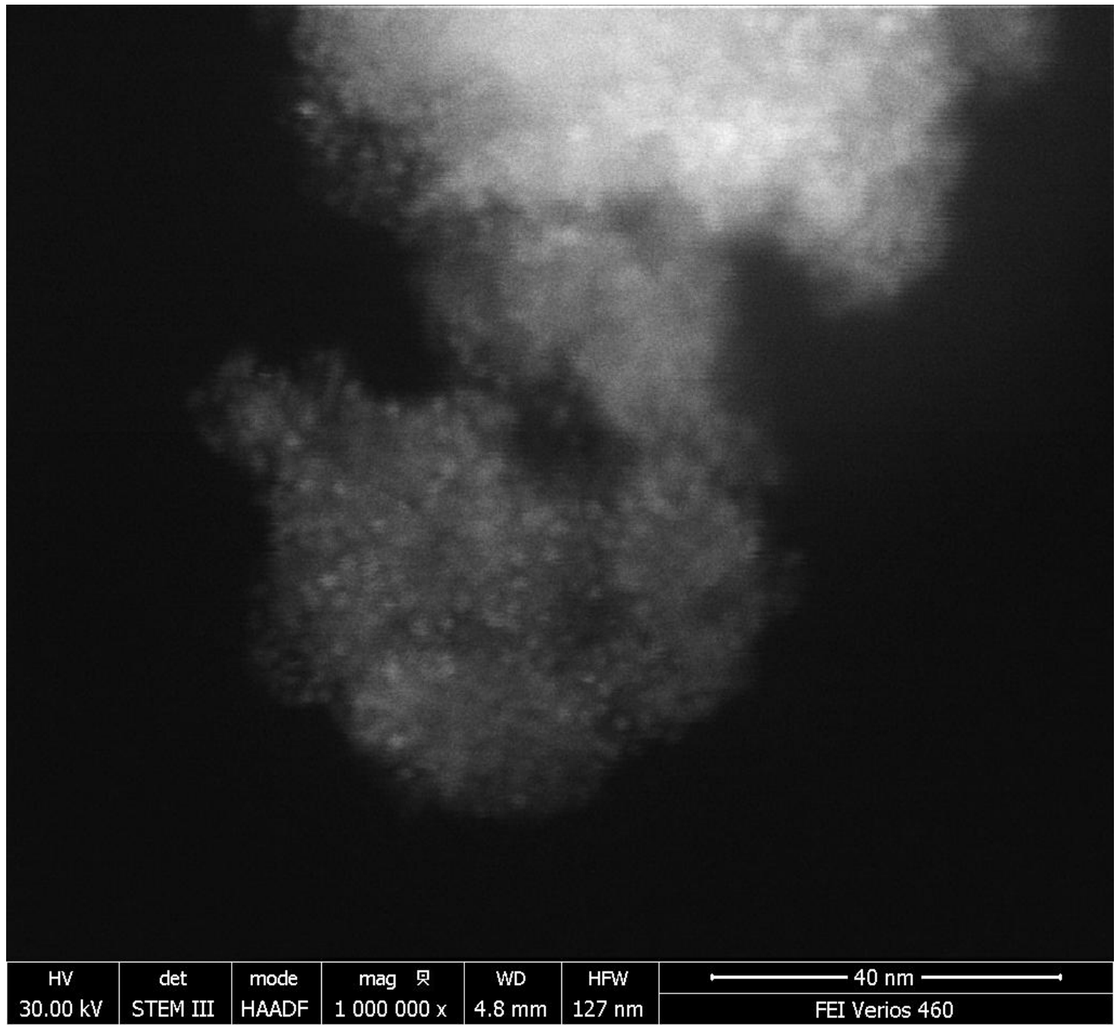
High Voltage: 2kV

Magnification: ×400k

Sample1: Pt@CeO



STEM-BF

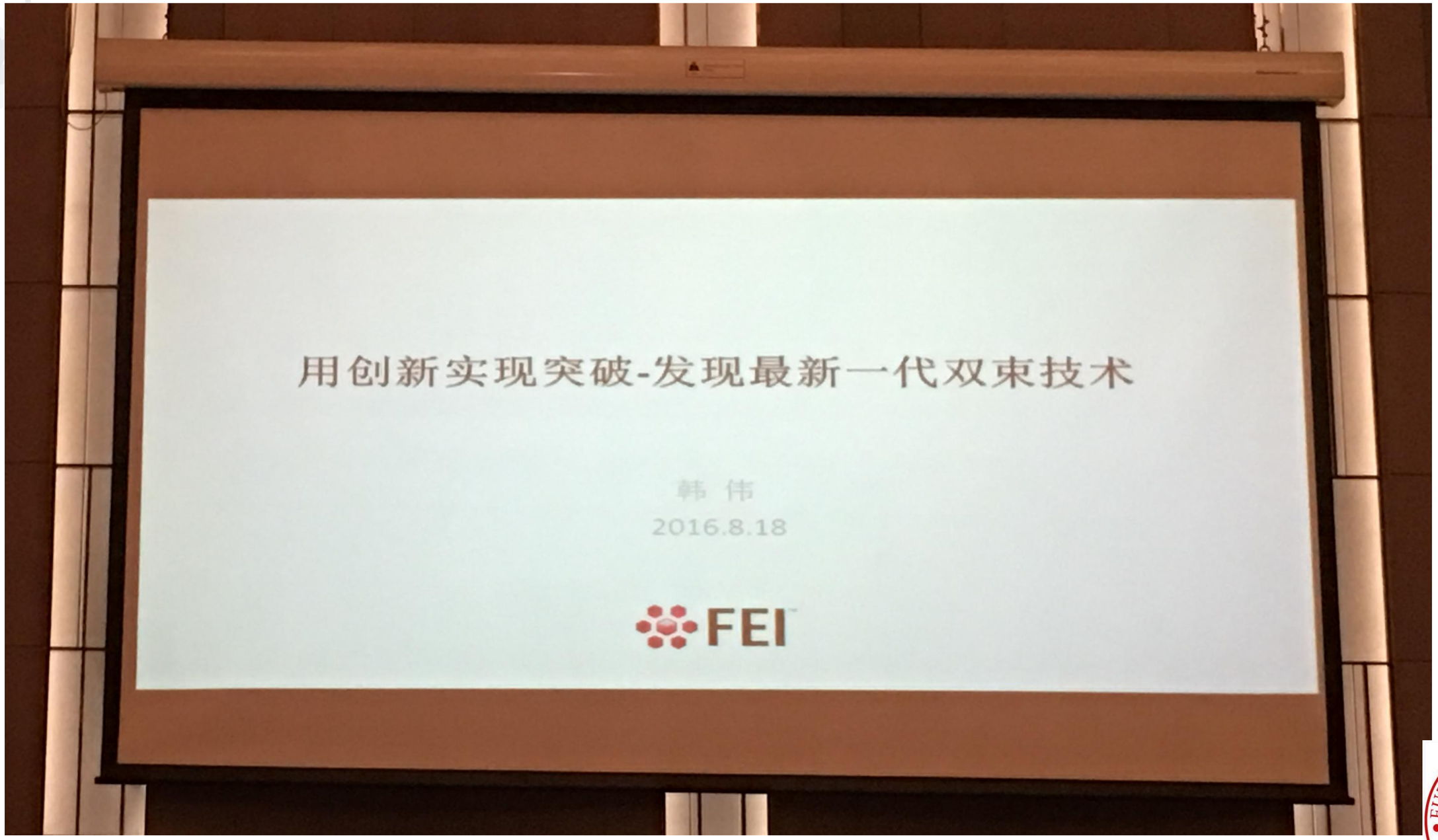


STEM-HAADF

High Voltage: 30kV

Magnification: ×1000k

四、用创新实现突破—发现最新一代双束技术



三、用创新实现突破—发现最新一代双束技术

Helios G4　2016年7月最新发布

Enabling breakthrough innovations with DualBeam™ — faster and easier than ever before

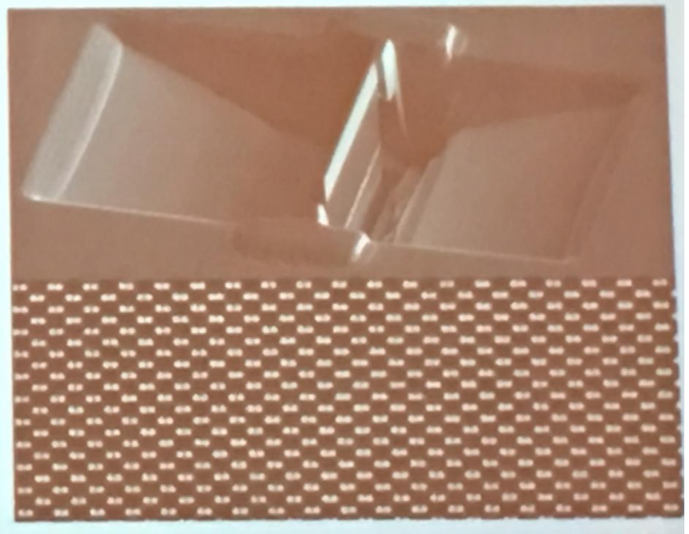
FEI

- **Fastest and easiest preparation** of highest quality samples for HR S/TEM and APT
- **Extreme high resolution imaging** with the most precise contrast
- **Access highest resolution**, multi-scale and multi-modal subsurface and 3D information
- **Fast, accurate, and precise milling and deposition** of complex structures with critical dimensions of less than 10 nm

Explore. Discover. Resolve.

Helios G4 enabling technologies for Sample Preparation

- **Guided TEM Sample Preparation** workflow
- **Phoenix FIB** with unmatched low voltage performance and 65 nA current with perfectly round spots
- **Elstar™ UC+** best-in-class electron column
- **EasyLift™** - fully integrated in-situ lift-out (INLO) solution
- High stability and accuracy **150mm piezo stage**
- Precise process **monitoring and endpointing**
- Different **sample preparation strategies**
- **Apps expertise and support**



FEI

Explore. Discover. Resolve.

Helios G4 UX

主要优点：

- 全新的Phoenix离子枪及其优异的低电压性能可保证最快速、最简单的高质量、定点的、超薄TEM和APT制样
- 使用最顶级的Elstar FEG的超高分辨成像、高稳定性和全自动性来实现最短时间获得微区信息
- 新一代的UC+单色器技术和大束流性能可显示最好的细节信息，确保低能量下的亚纳米性能
- 多达 6 个一体化镜筒内和透镜下方探测器来保证获得精确的、超清晰的、无荷电衬度图像

Helios G4 UX

主要优点：

- 选购Auto Slice & ViewTM 4 (AS&V4)软件可实现对目标区域最精准定位、最高质量、全自动收集多模式3D数据信息
- 实现临界尺寸低于 10 nm 的最复杂多变结构的快速、准确精密刻蚀和沉积
- 得益于高稳定度150mm压电陶瓷样品台和内置彩色光学导航系统，可对于每一个应用需求制定最适合的样品管理一体化集成的样品清洁度管理和专用成像方式，例如FEISmartSCAN™ 和 DCFI来获得最税利的成像

Helios G4 UX　技术参数

电压范围：

· 电子束着陆电压：20 V - 30 kV
· 电子束加速电压：200V – 30kV
· 离子束加速电压：500 V - 30 kV

电子束分辨率 @ 最佳 WD：

（需要进行位点测量来保证分辨率规格）

- 0.6nm@30 kV (STEM*)
- 0.7nm@1 kV
- 1.0 nm@500 V (ICD*)

电子束分辨率 @ 交叉点：

- 0.6 nm@15 kV
- 1.2 nm@1 kV

探针电流：

· 电子束：0.8 pA - 100 nA
· 离子束：0.1 pA - 65 nA（15 孔光阑条）

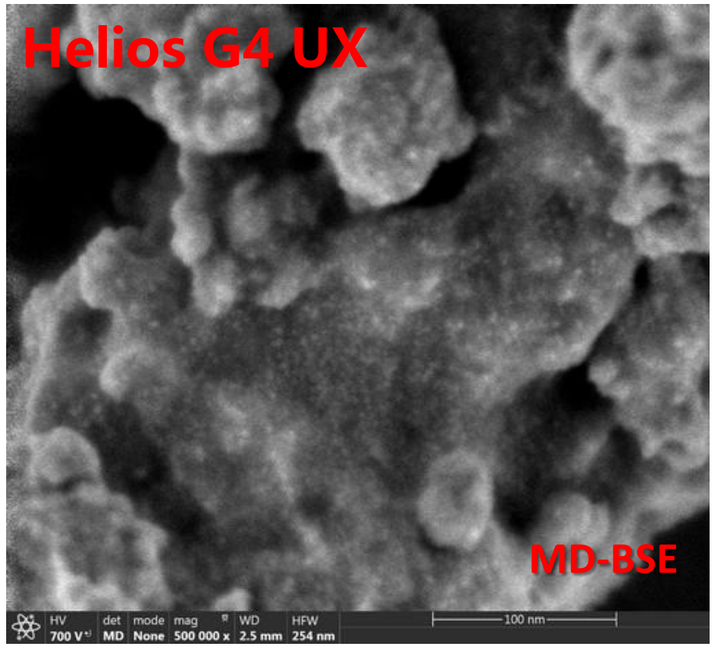
最大水平视场宽度：

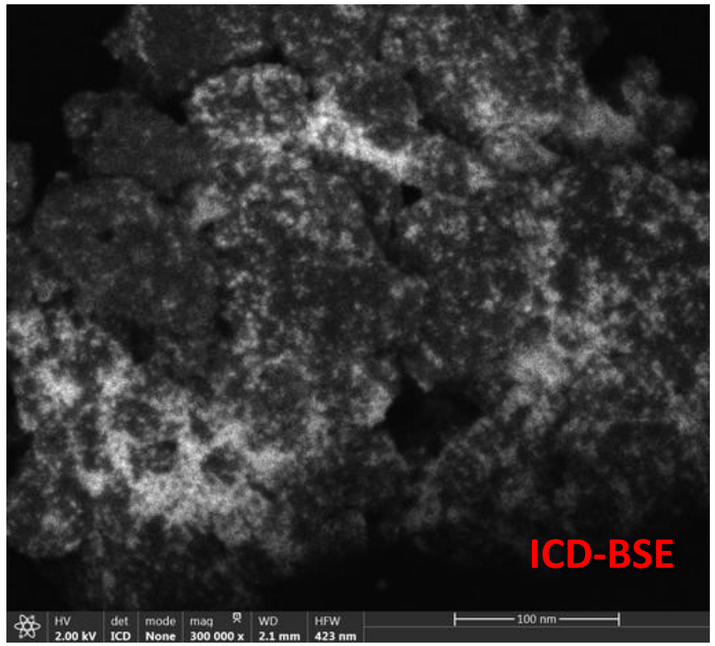
· 电子束：2.3 mm @ 束交叉点(WD 4 mm)
· 离子束：0.9 mm @束交叉点

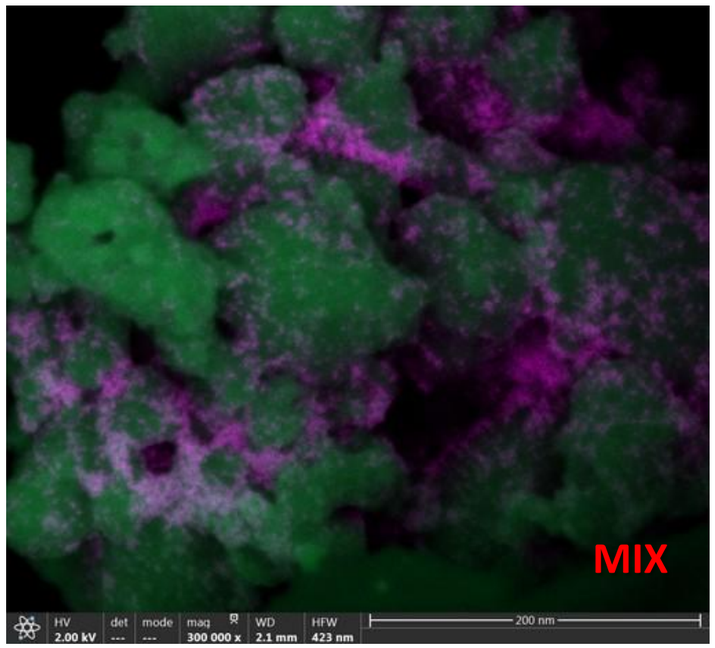
离子束分辨率 @ 交叉点：

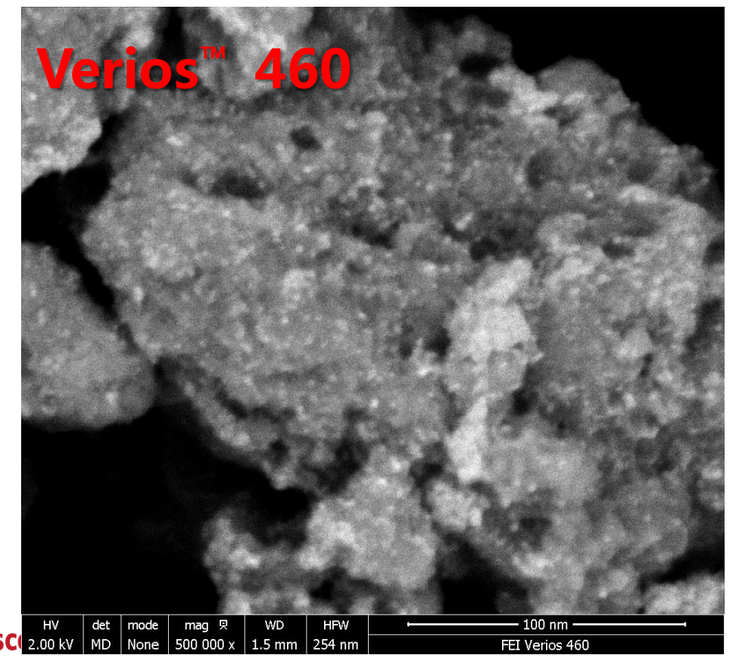
· 4.0 nm/30 kV，使用首选的统计方法
· 2.5 nm/30 kV，使用精选的边界方法

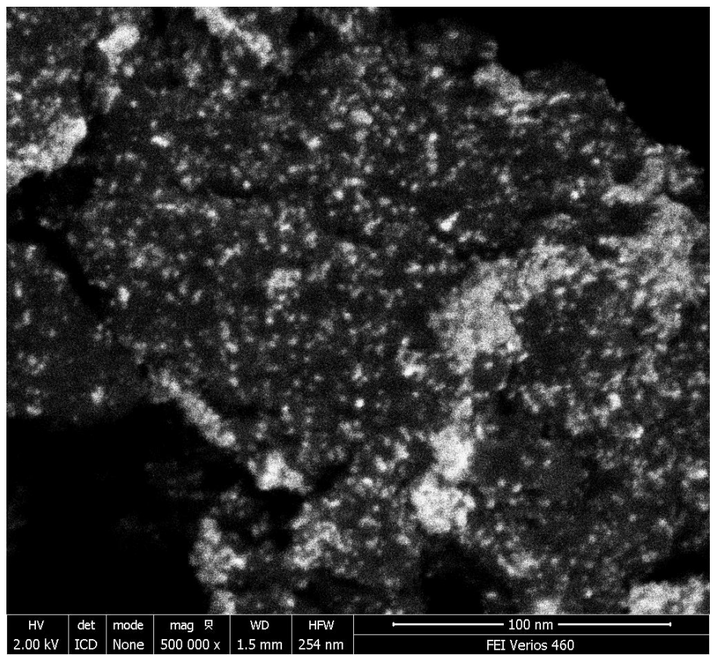
Sample1: Pt@CeO

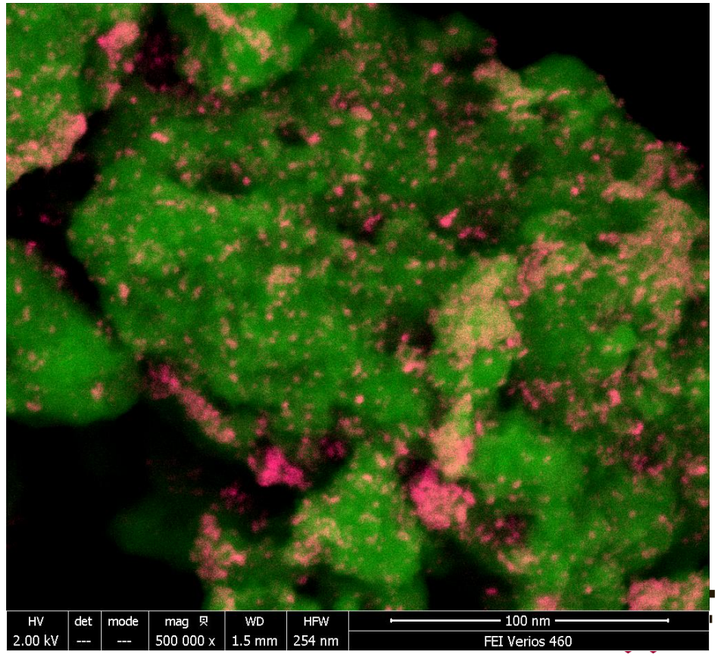






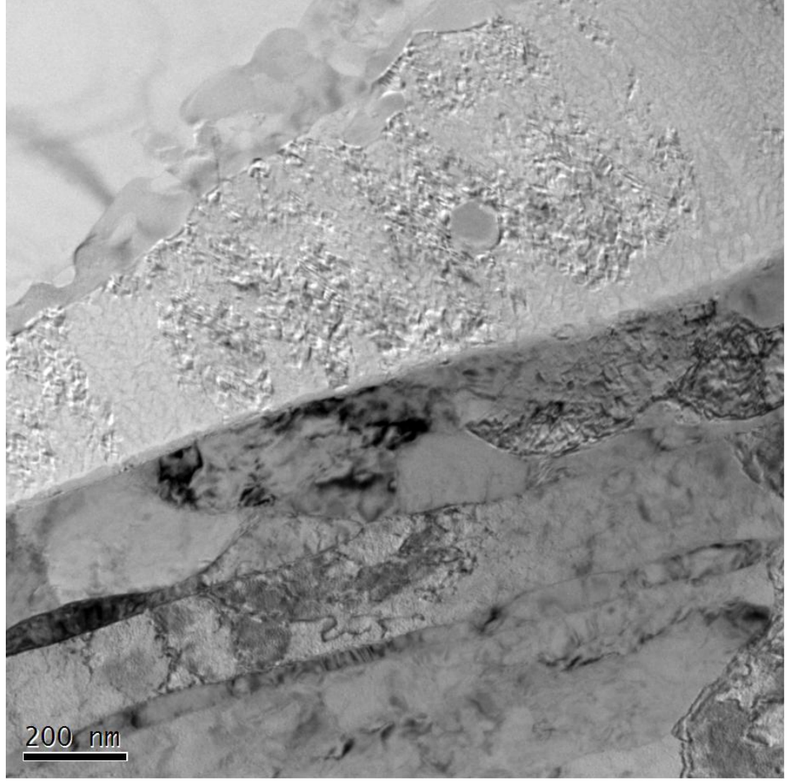


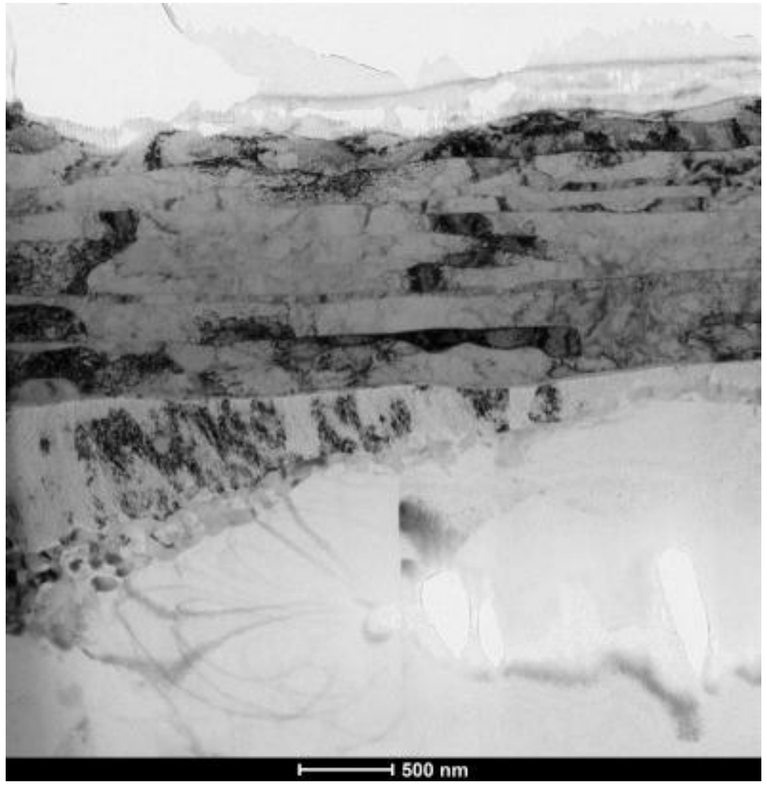


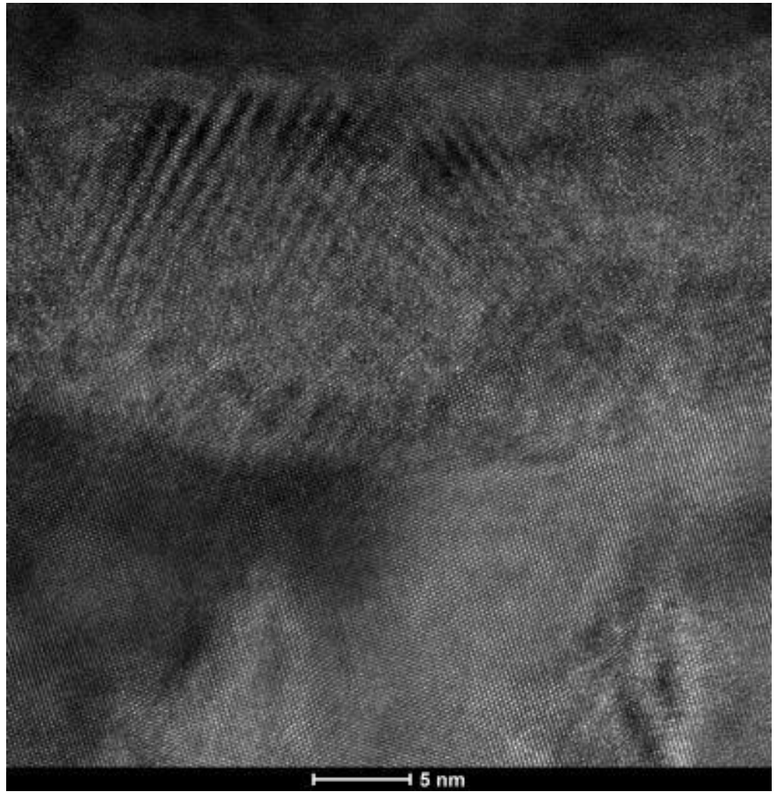


双束扫描电镜的聚焦离子束切割制样

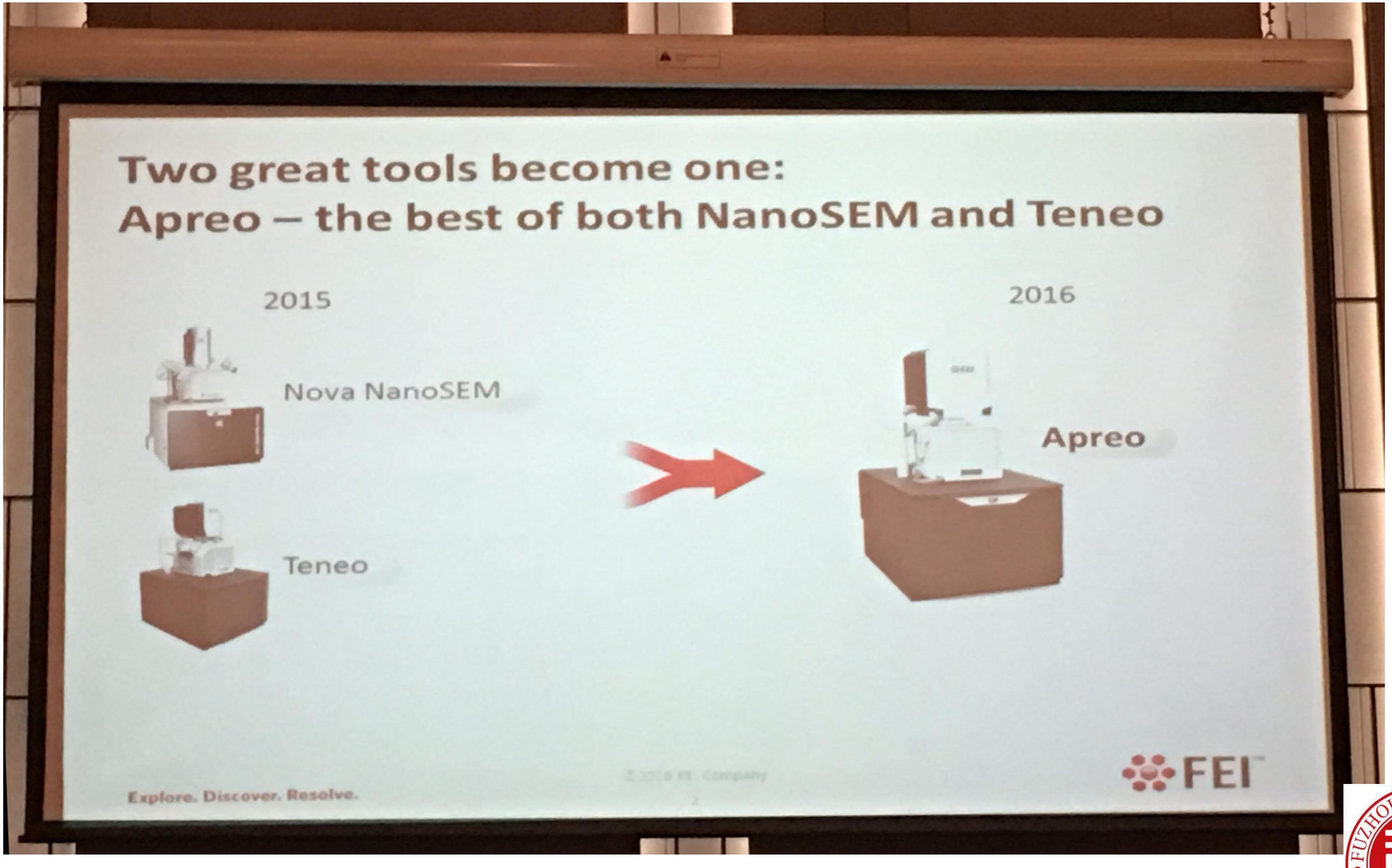
5#铝/钢焊接界面



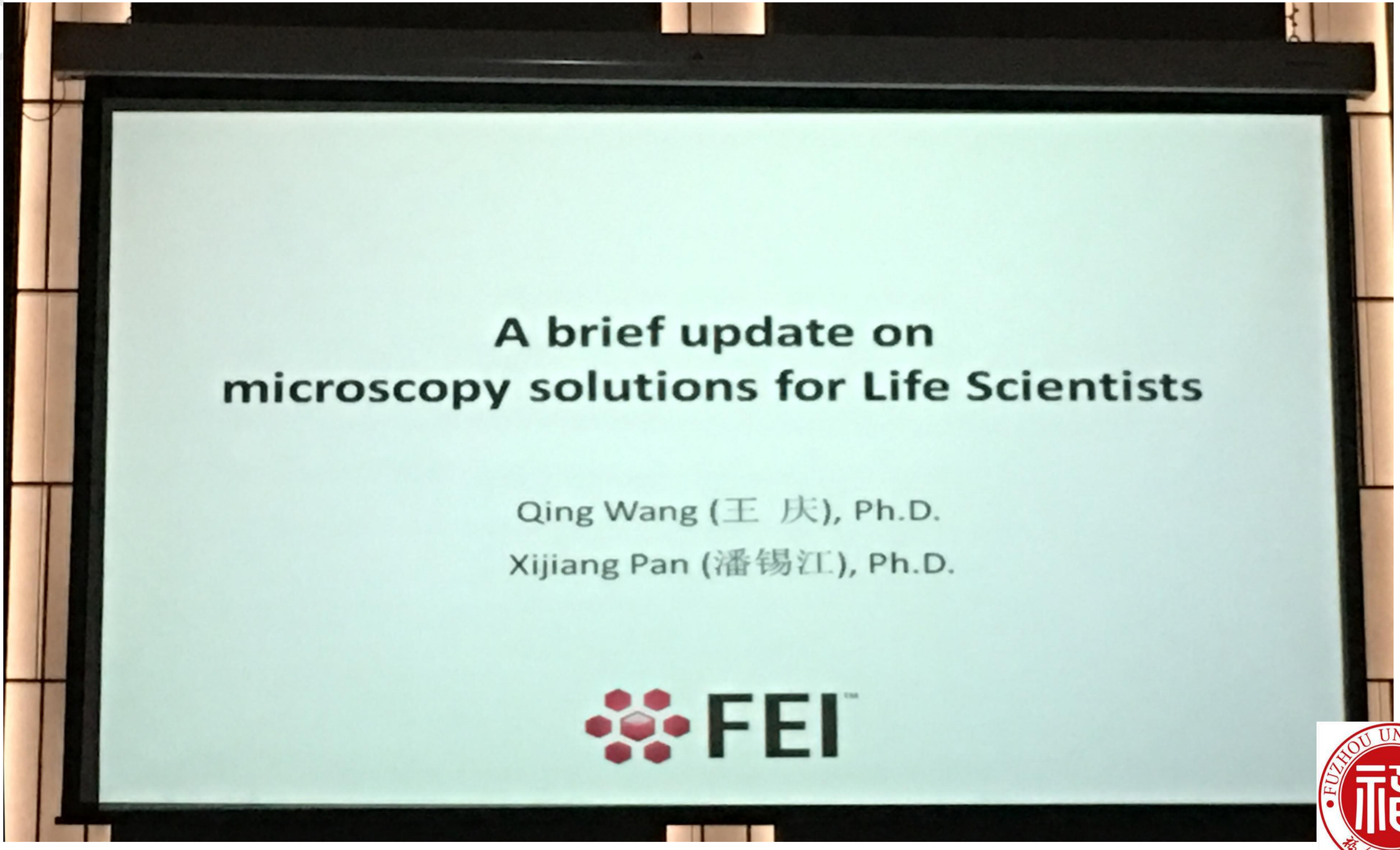




五、Apreo新型扫描电镜


Two great tools become one:
Apreo – the best of both NanoSEM and Teneo
2015
2016
Nova NanoSEM
Teneo
Apreo
Explore. Discover. Resolve.
FEI

六、冷冻电镜在生命科学方面的应用



Thank you!