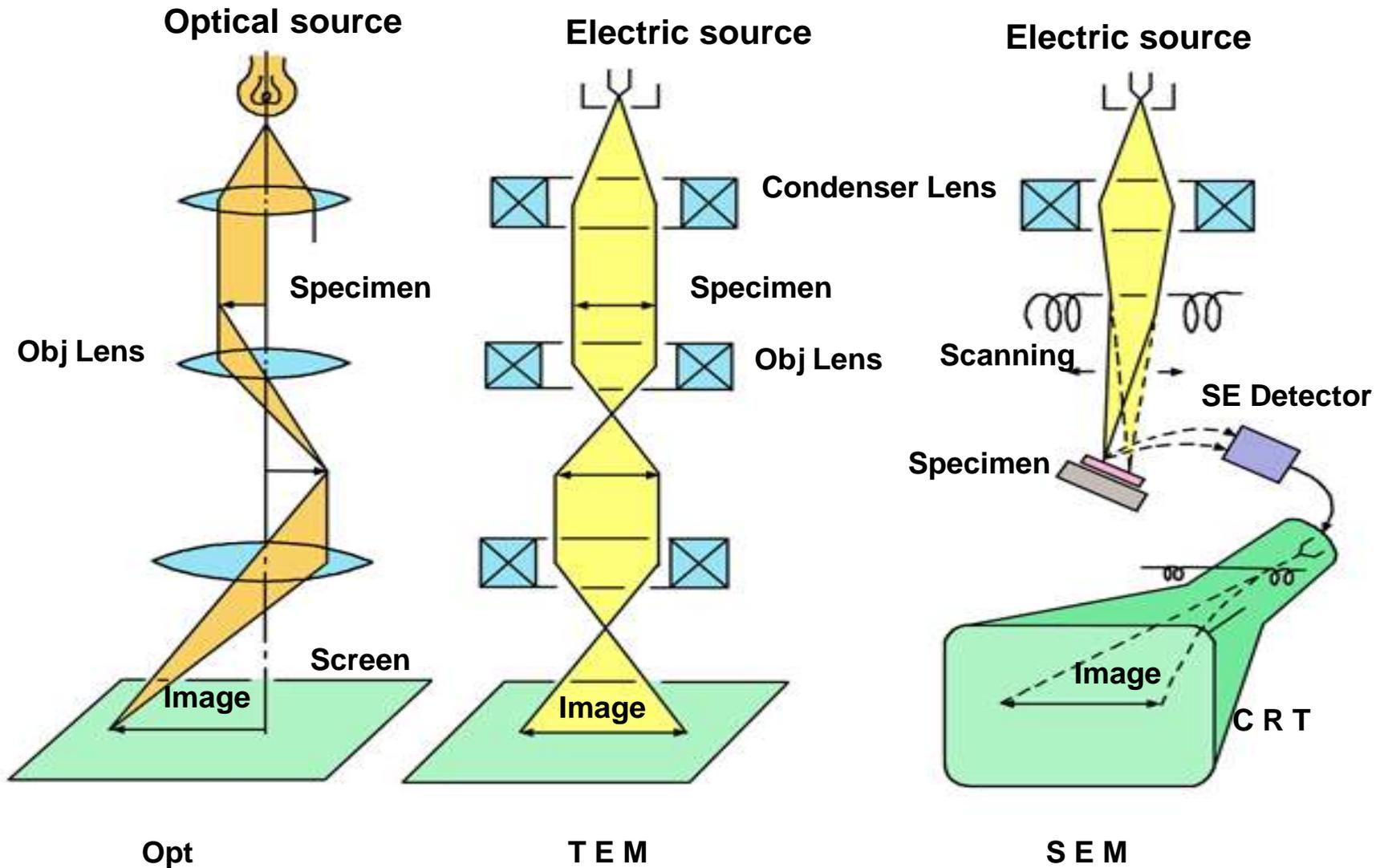
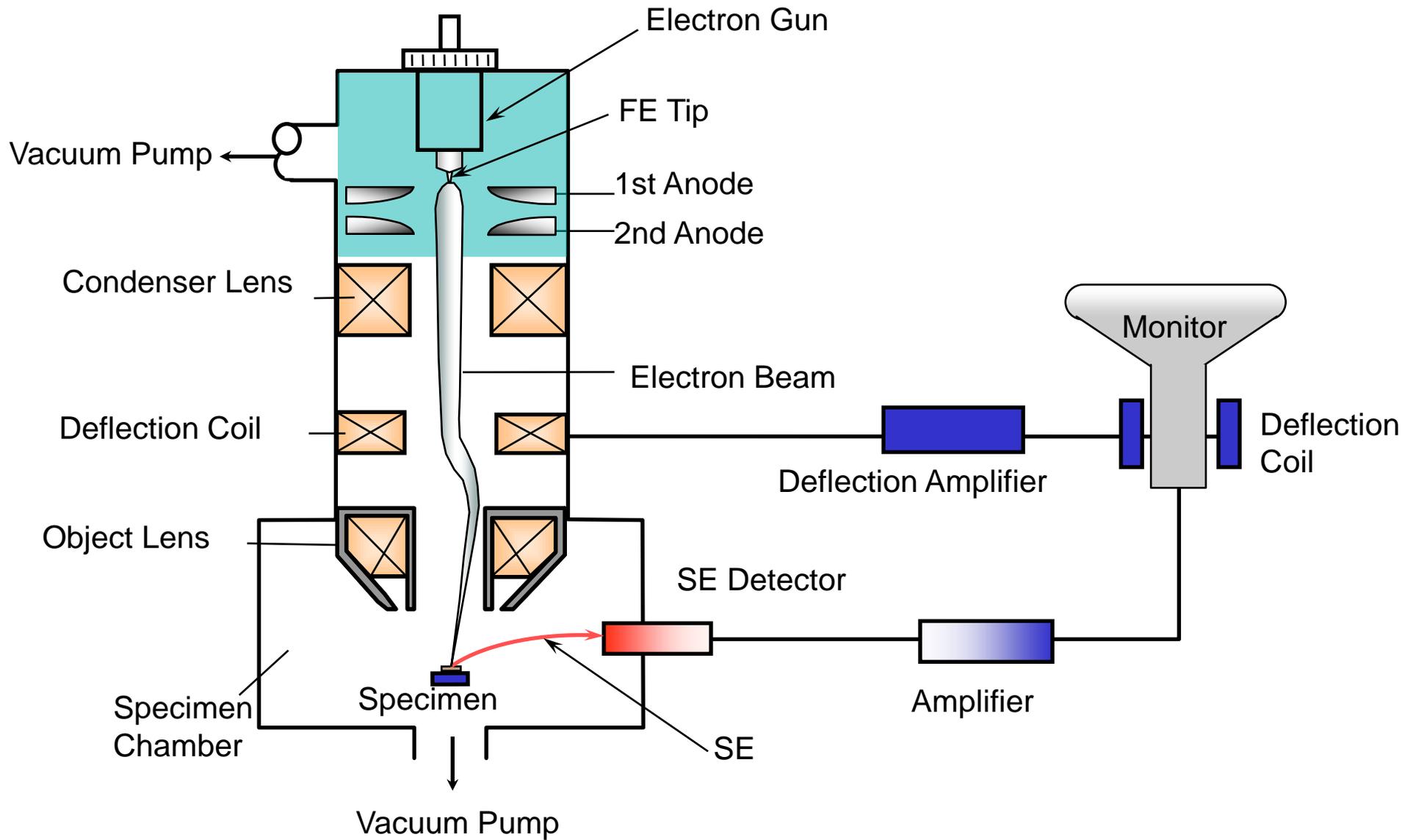


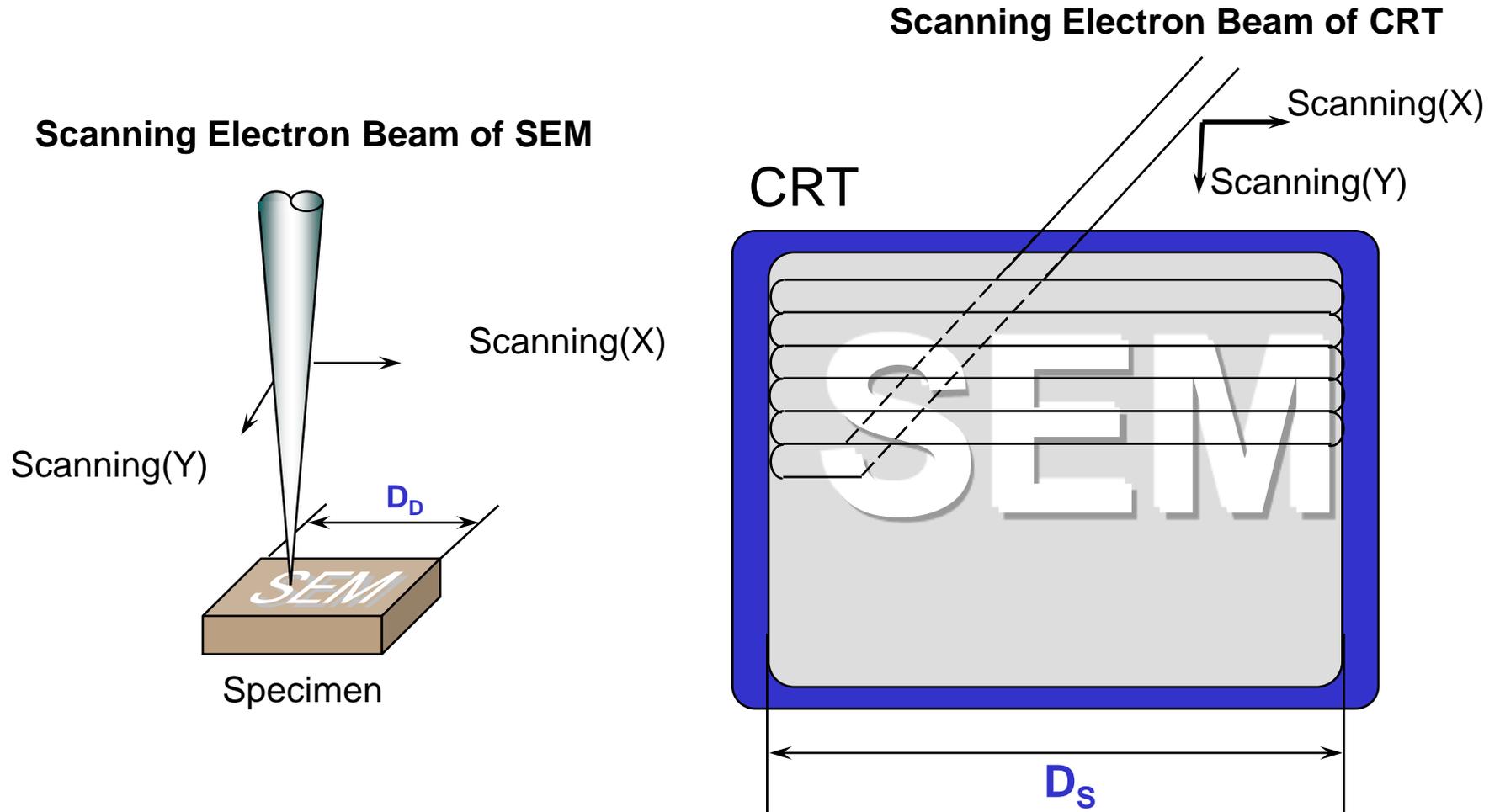


FE-SEM BASIC

HITACHI







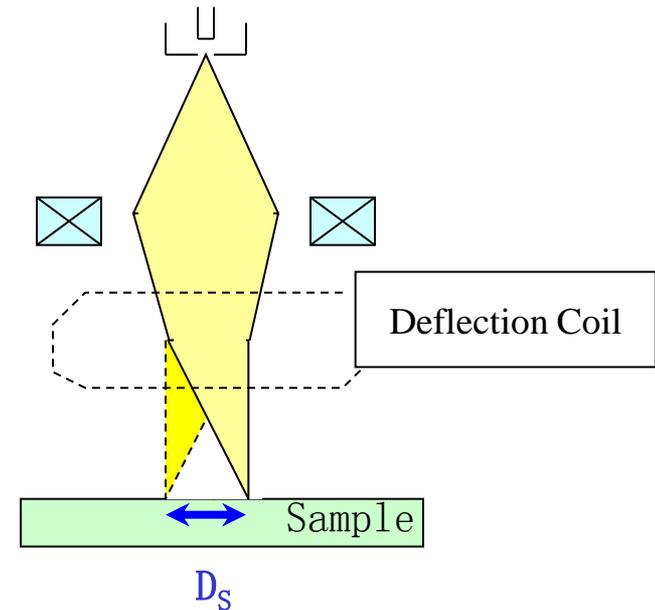
Magnification : (M) = D_s / D_D

**Hitachi SEM's Magnification is base on the size of 4x5 inch film.
(Otherwise CD-SEM is base on the size of Monitor's Window)**

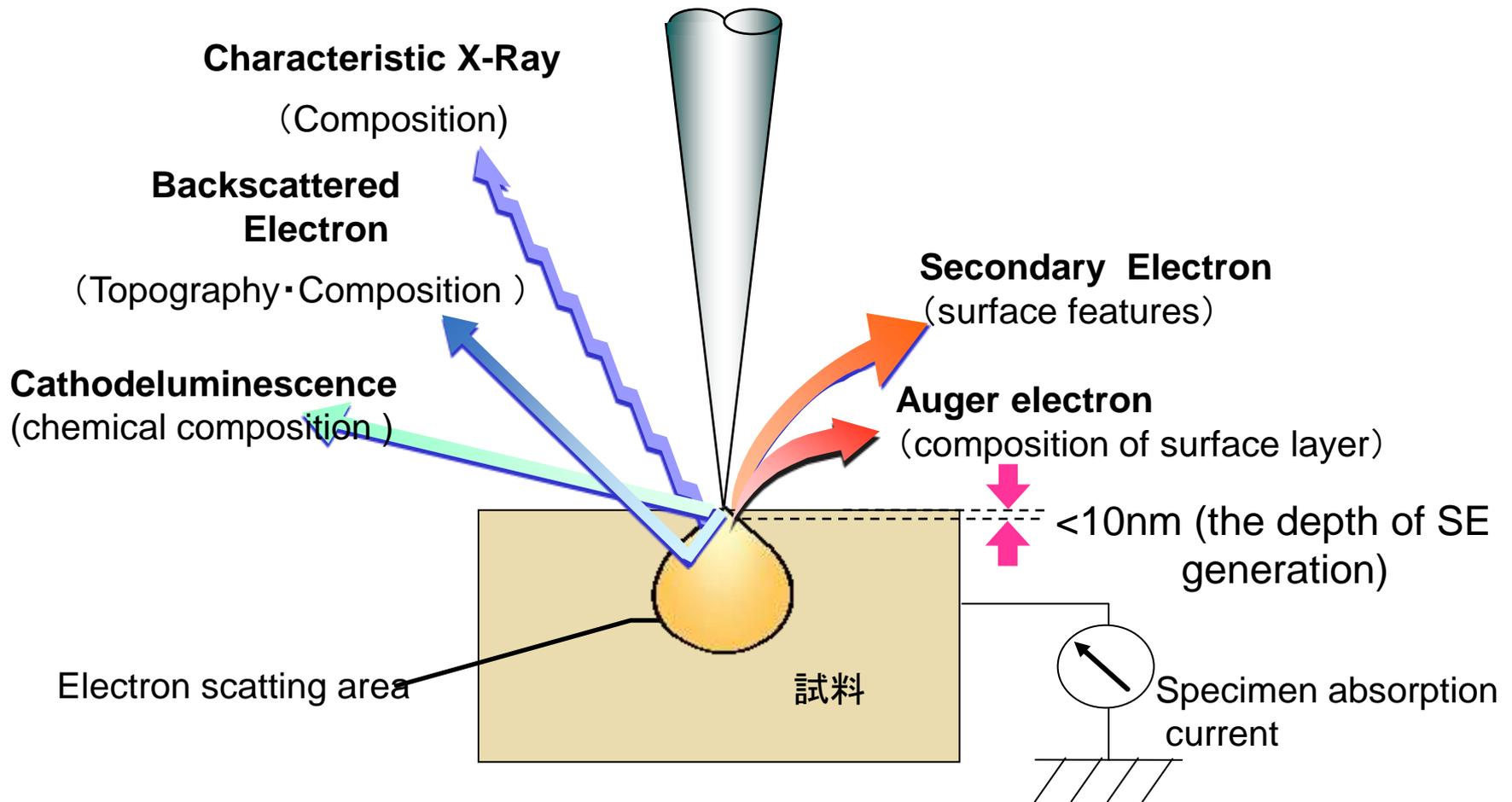


4×5 inch Film

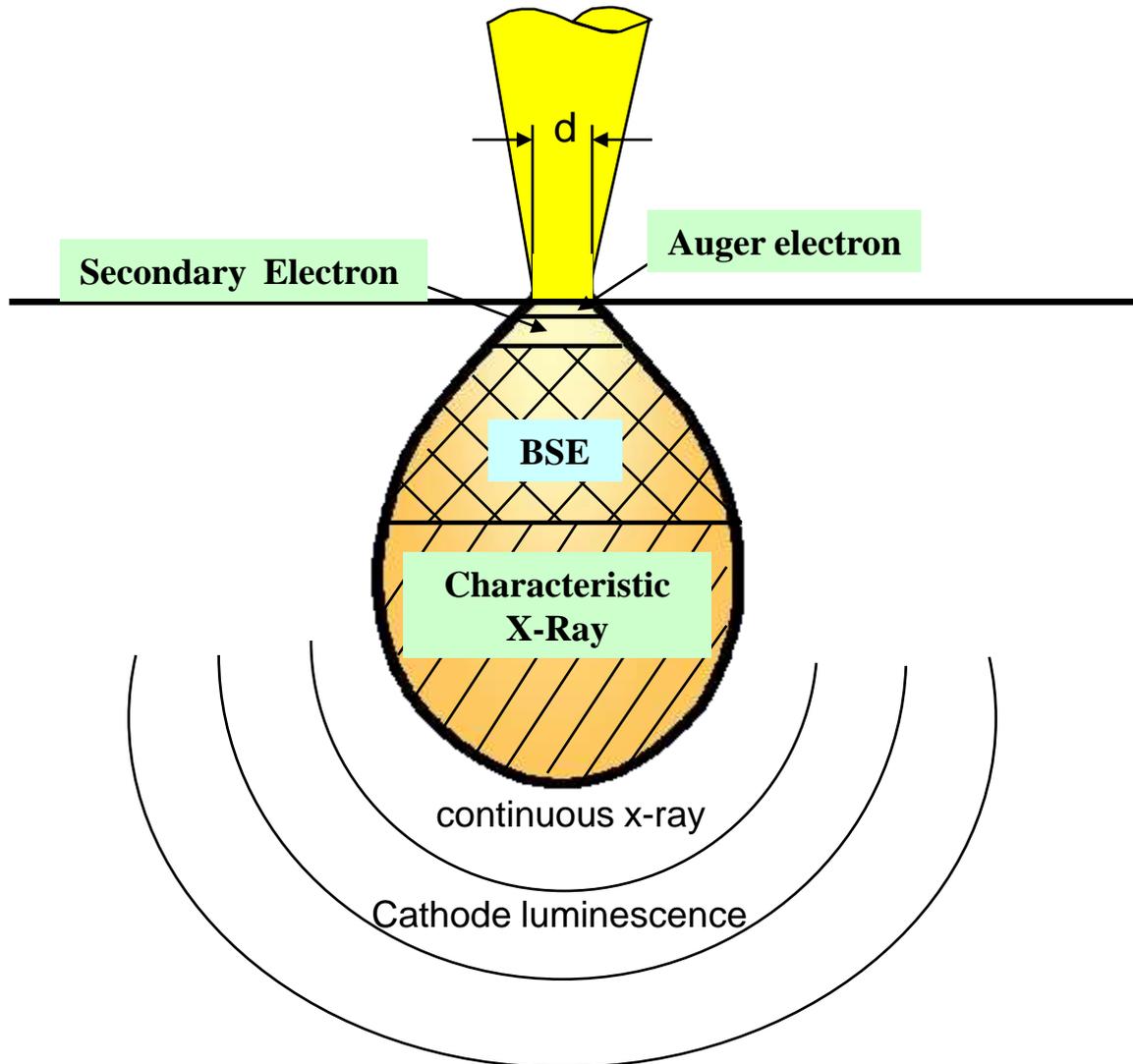
$$(M) = D_S / D_D$$



Primary Electron Beam (~30kV)

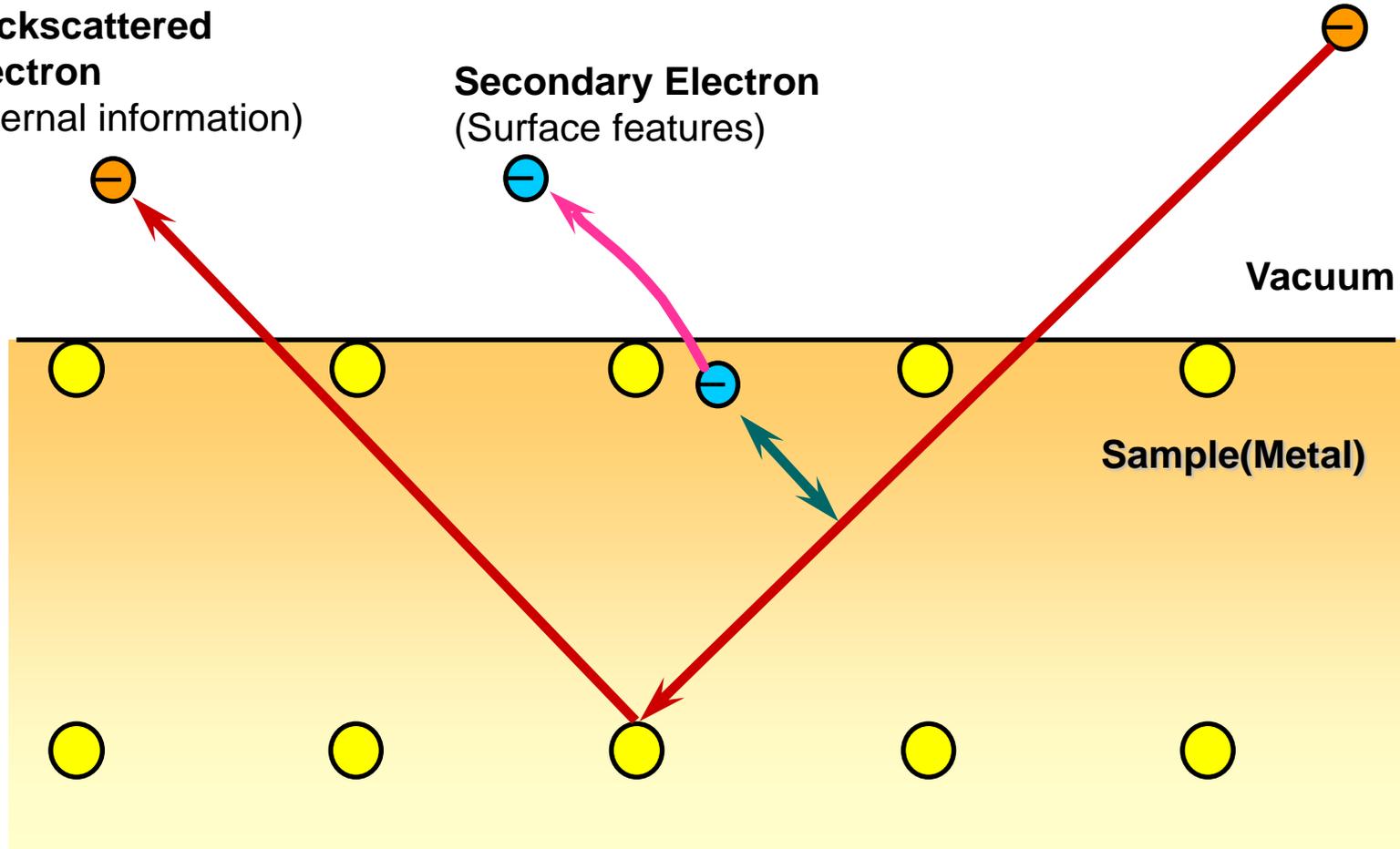


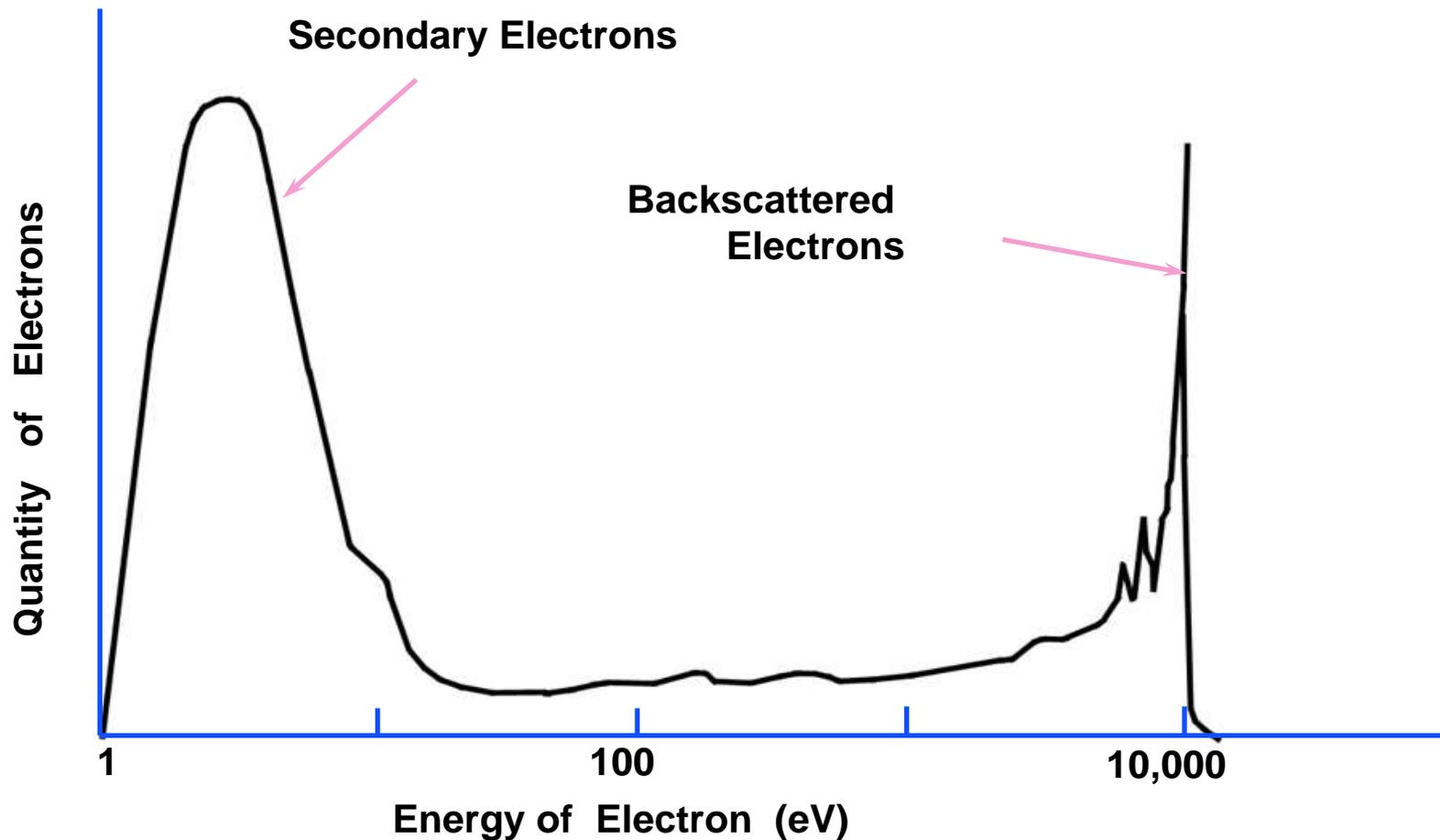
Primary Electron Beam ($\sim 30\text{kV}$)



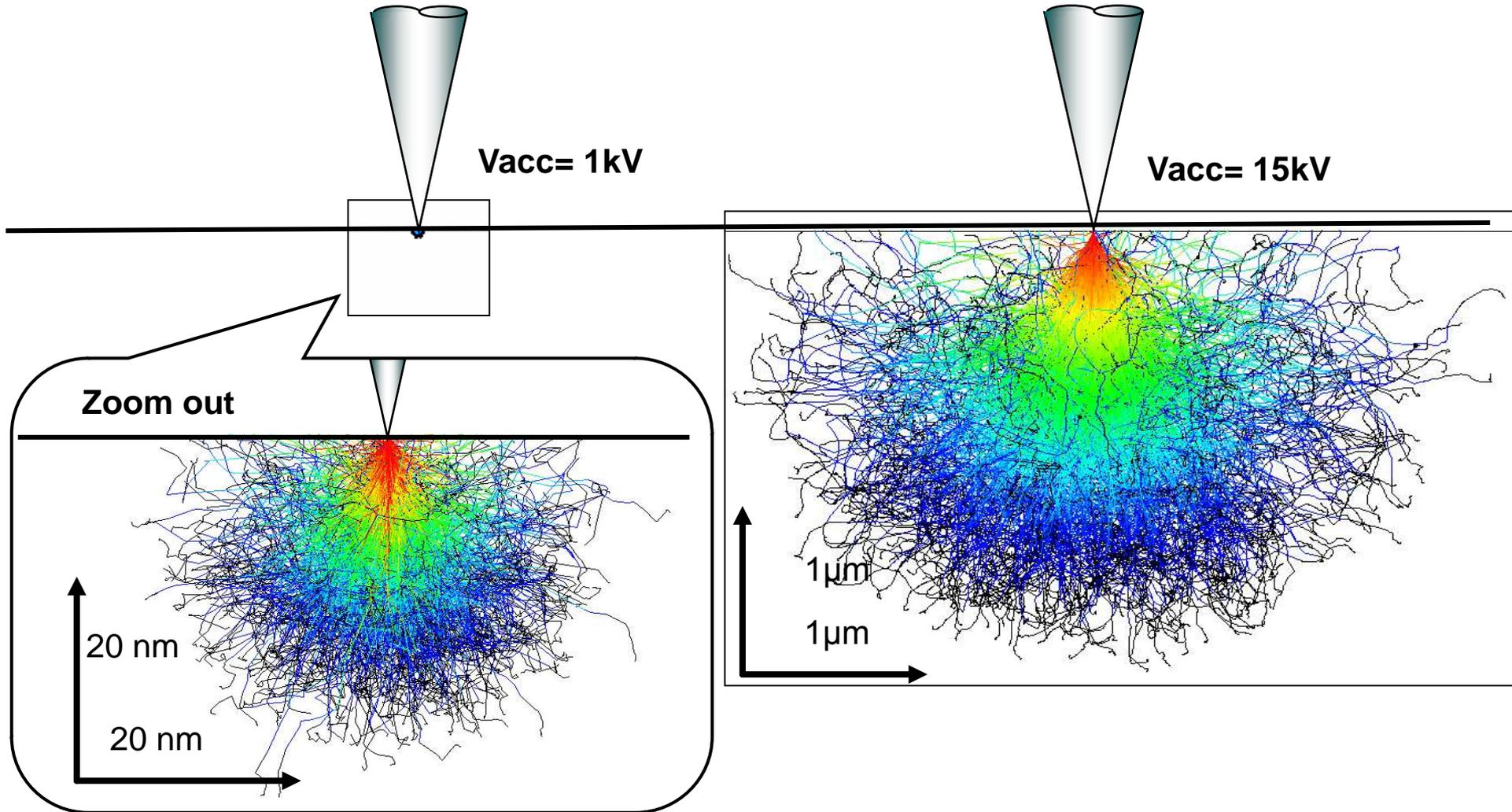
**Backscattered
Electron**
(internal information)

Secondary Electron
(Surface features)

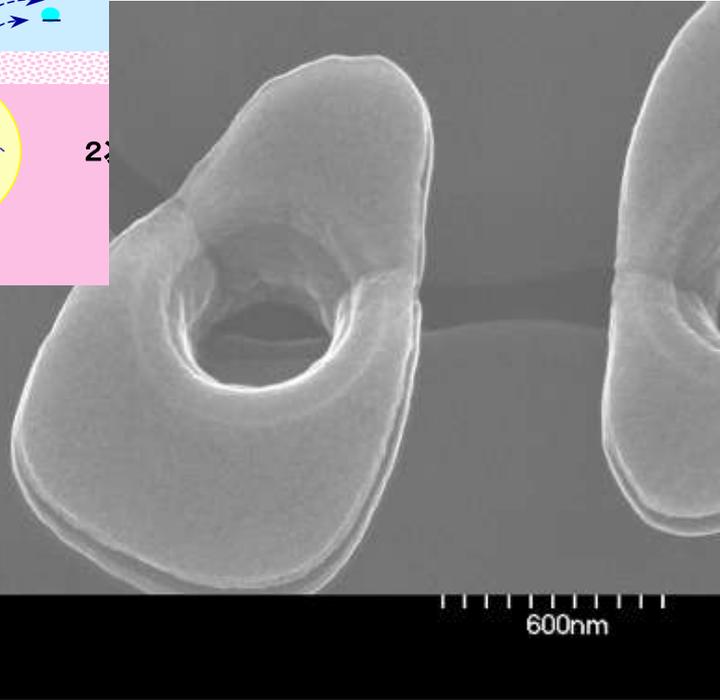
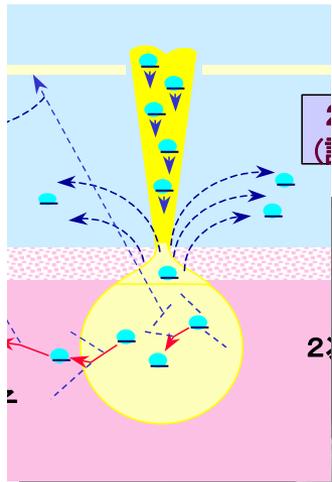




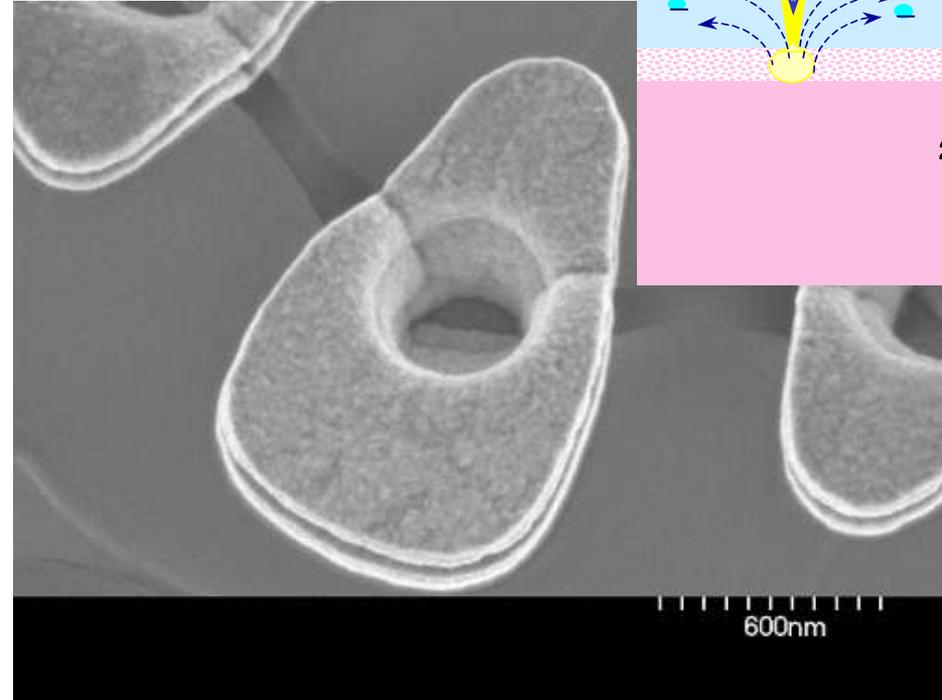
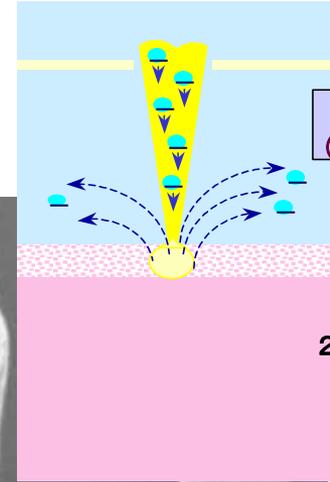
(Incident beam energy : 10,000eV)



Specimen:Carbon



Vacc=20kV

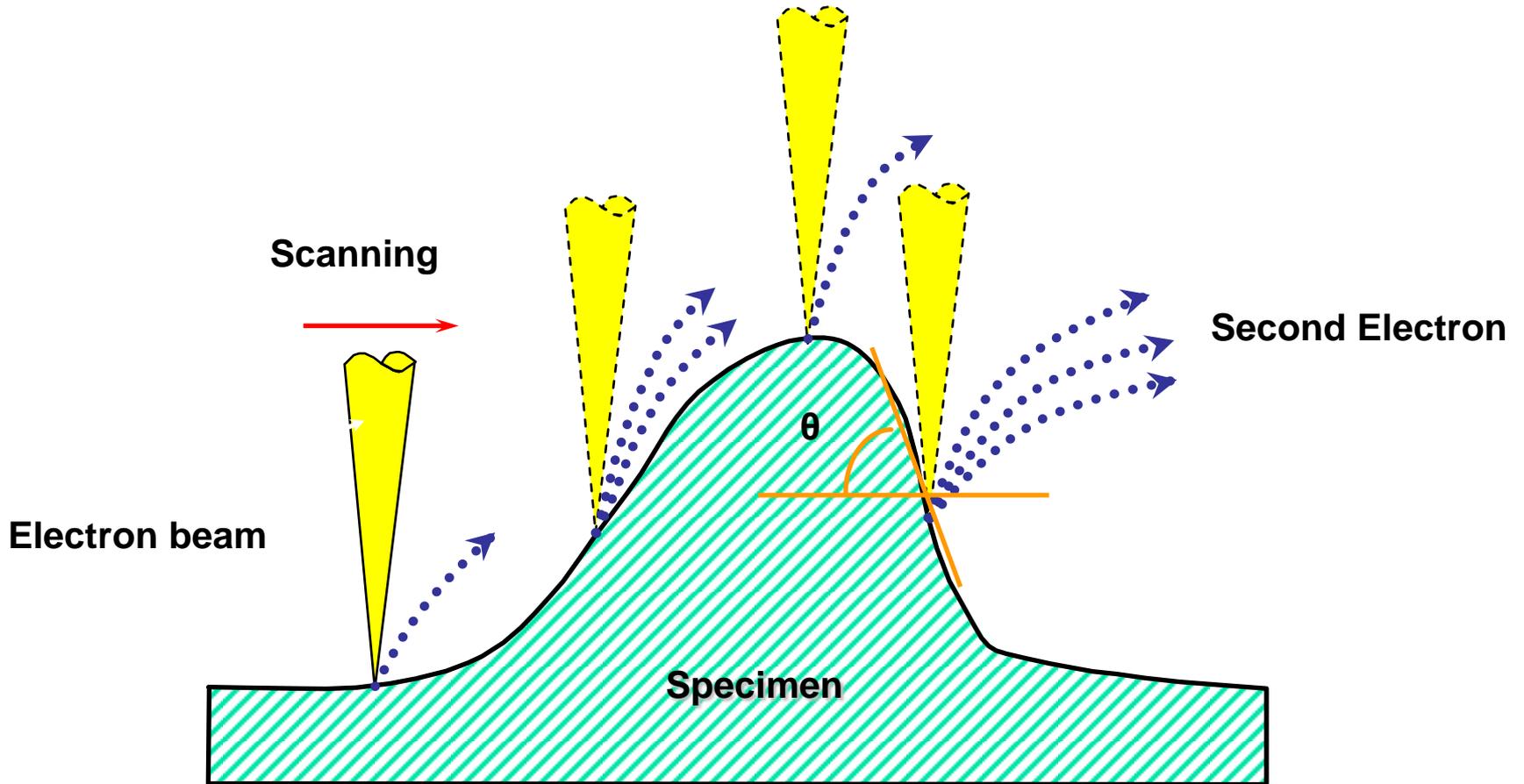


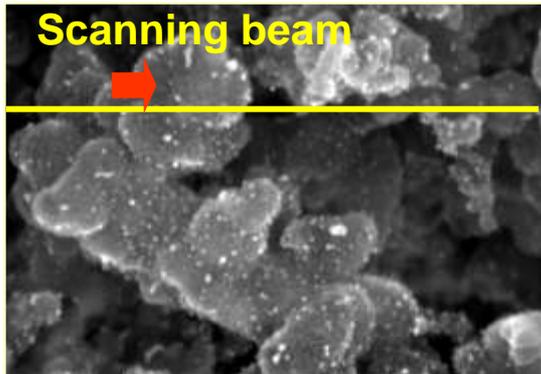
Vacc=1.0kV

Specimen : 16MDRAM Capacitor
Magnification : x50k

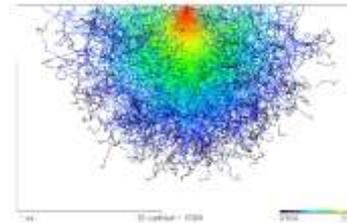
Emitted SE amount vary depending on

topography
composition
Potential difference

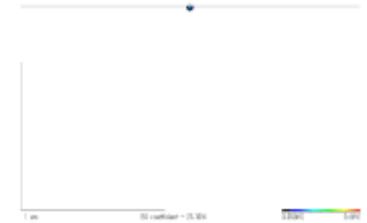




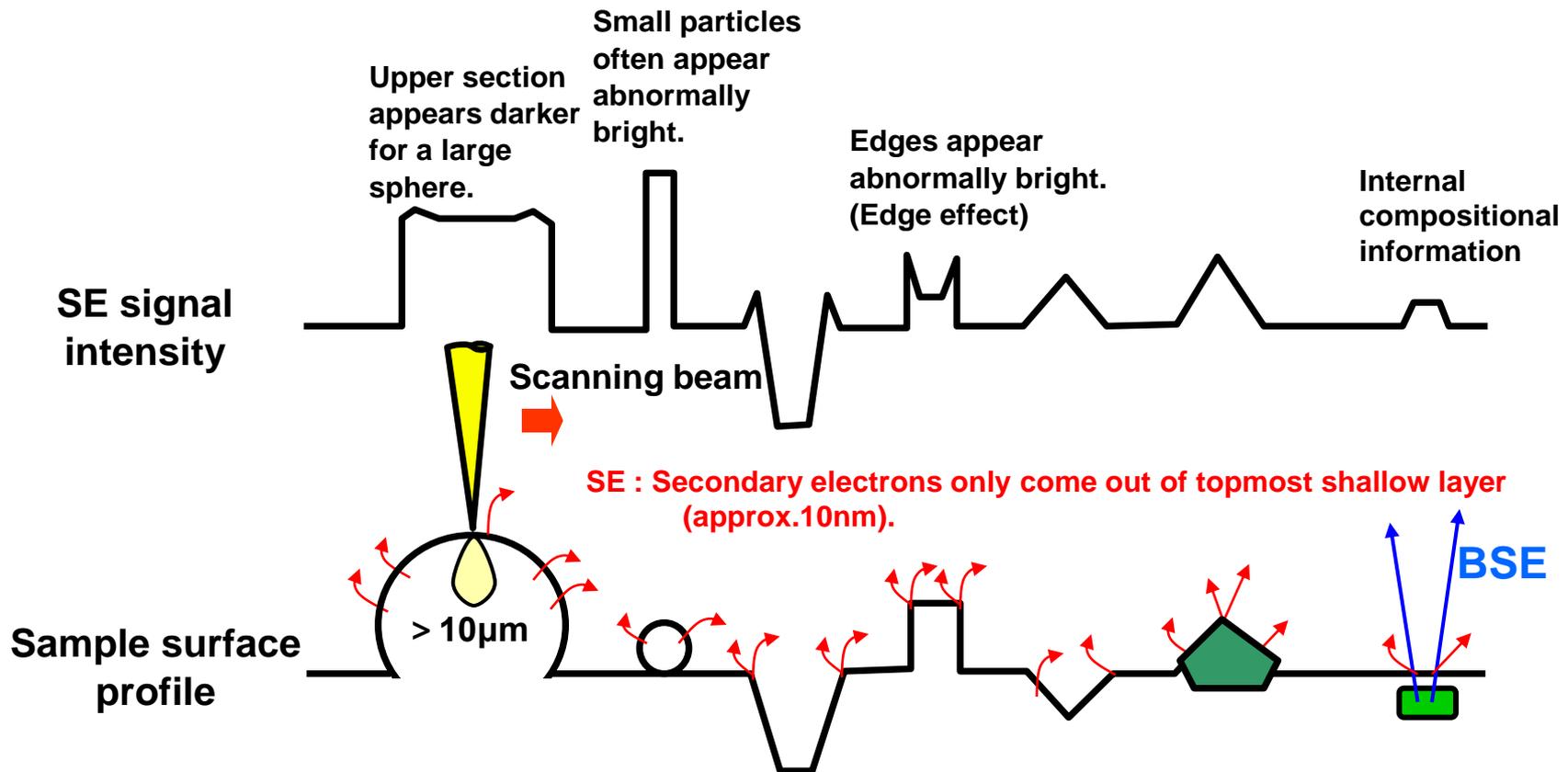
Vacc : 10kV

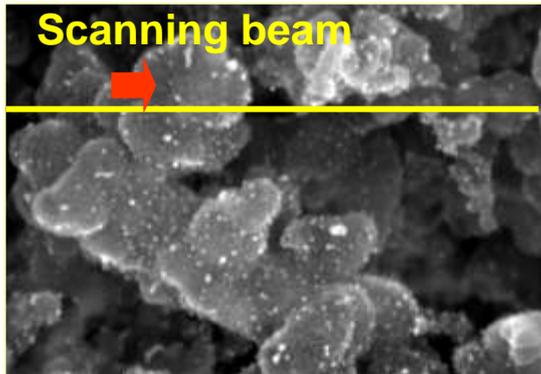


Vacc : 1kV

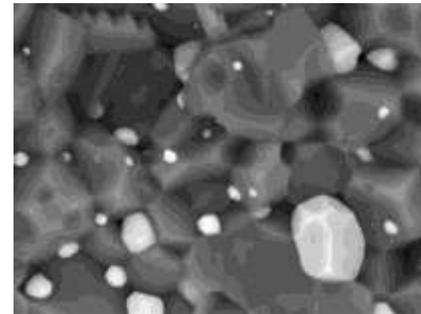


Monte Carlo simulation
Comparison of scattering region of incident electrons (Sample : Si)

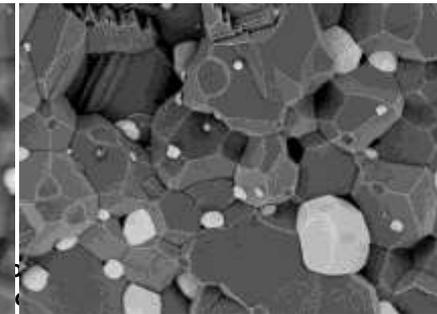




Vacc : 10kV



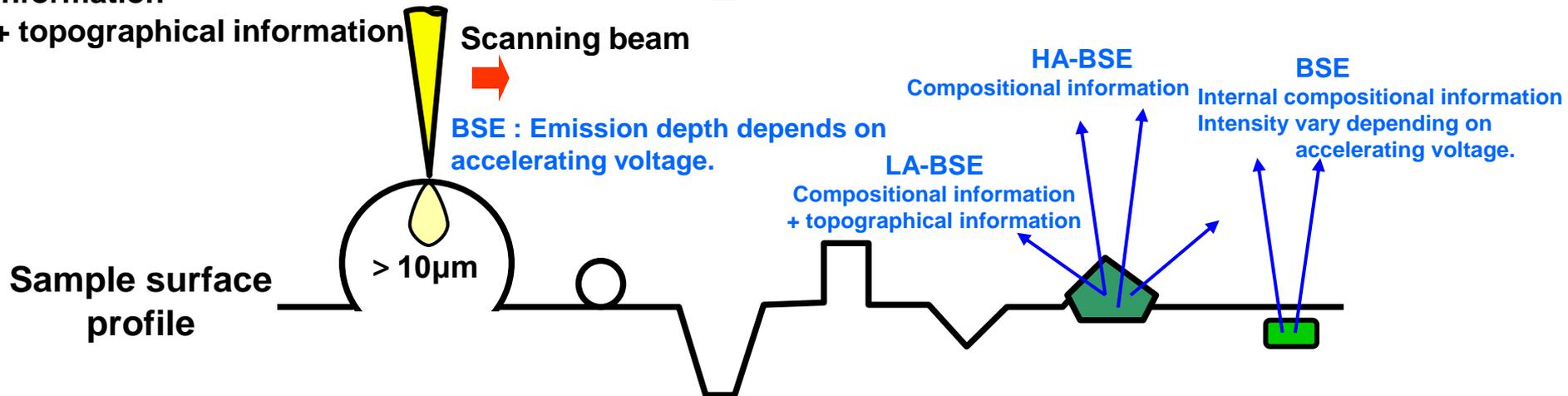
Vacc : 1kV



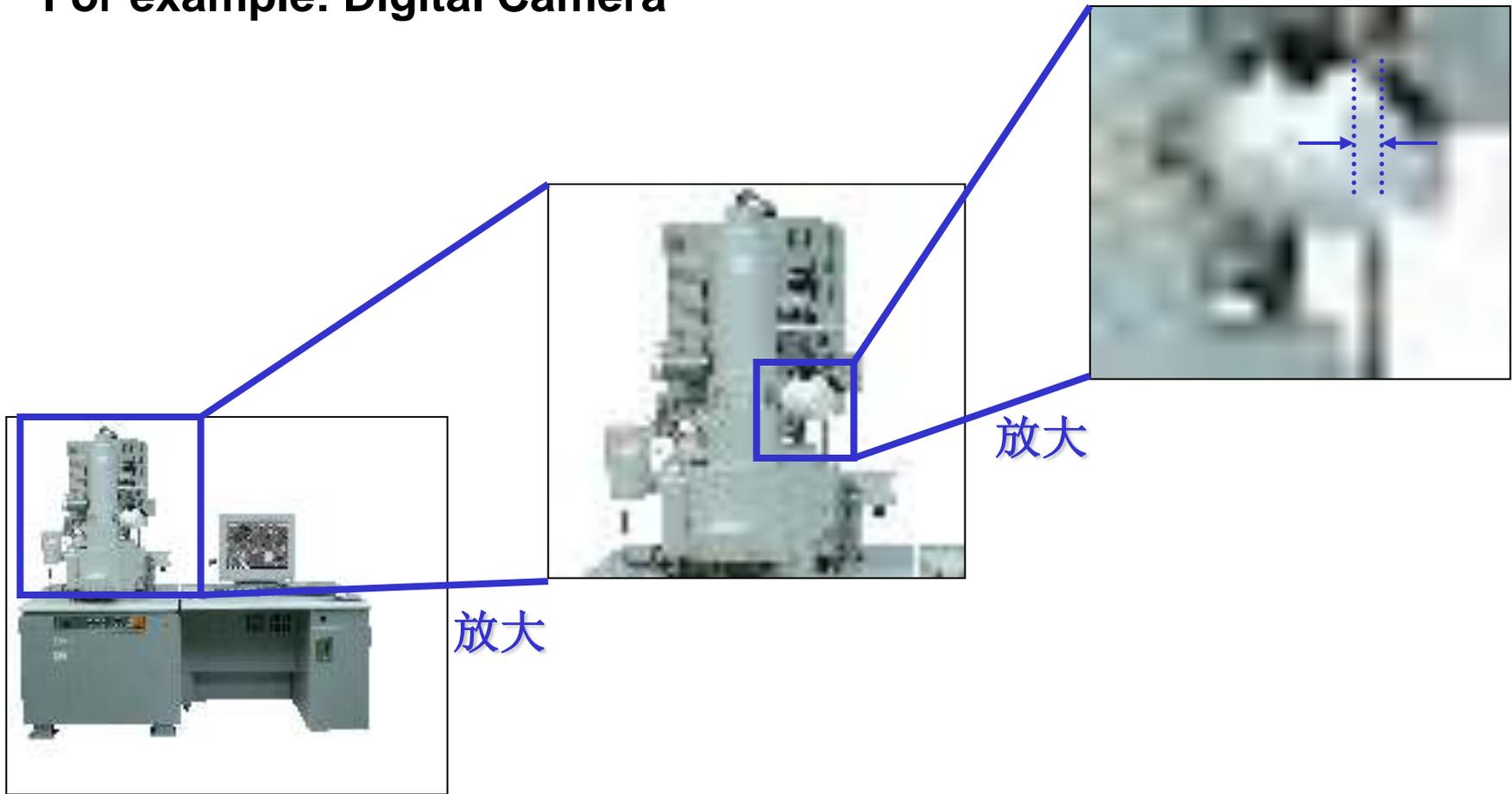
Sample : Ni-Al alloy

HA-BSE intensity
compositional/channeling
information

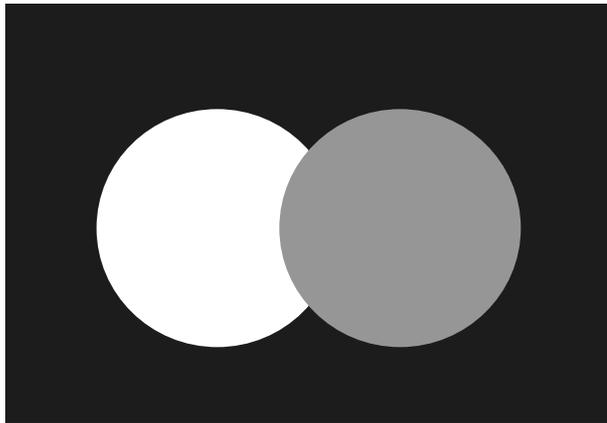
LA-BSE intensity
compositional/channeling
information
+ topographical information



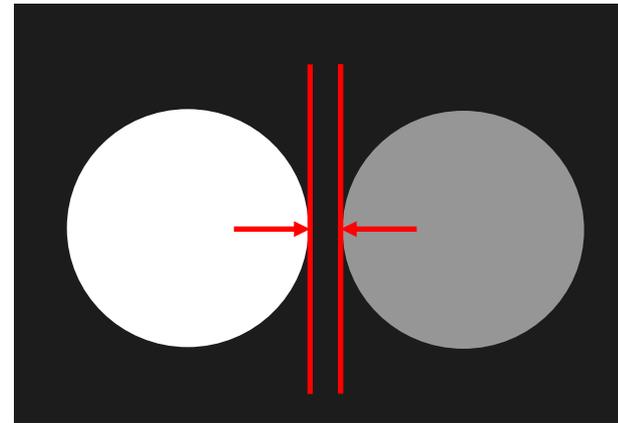
For example: Digital Camera



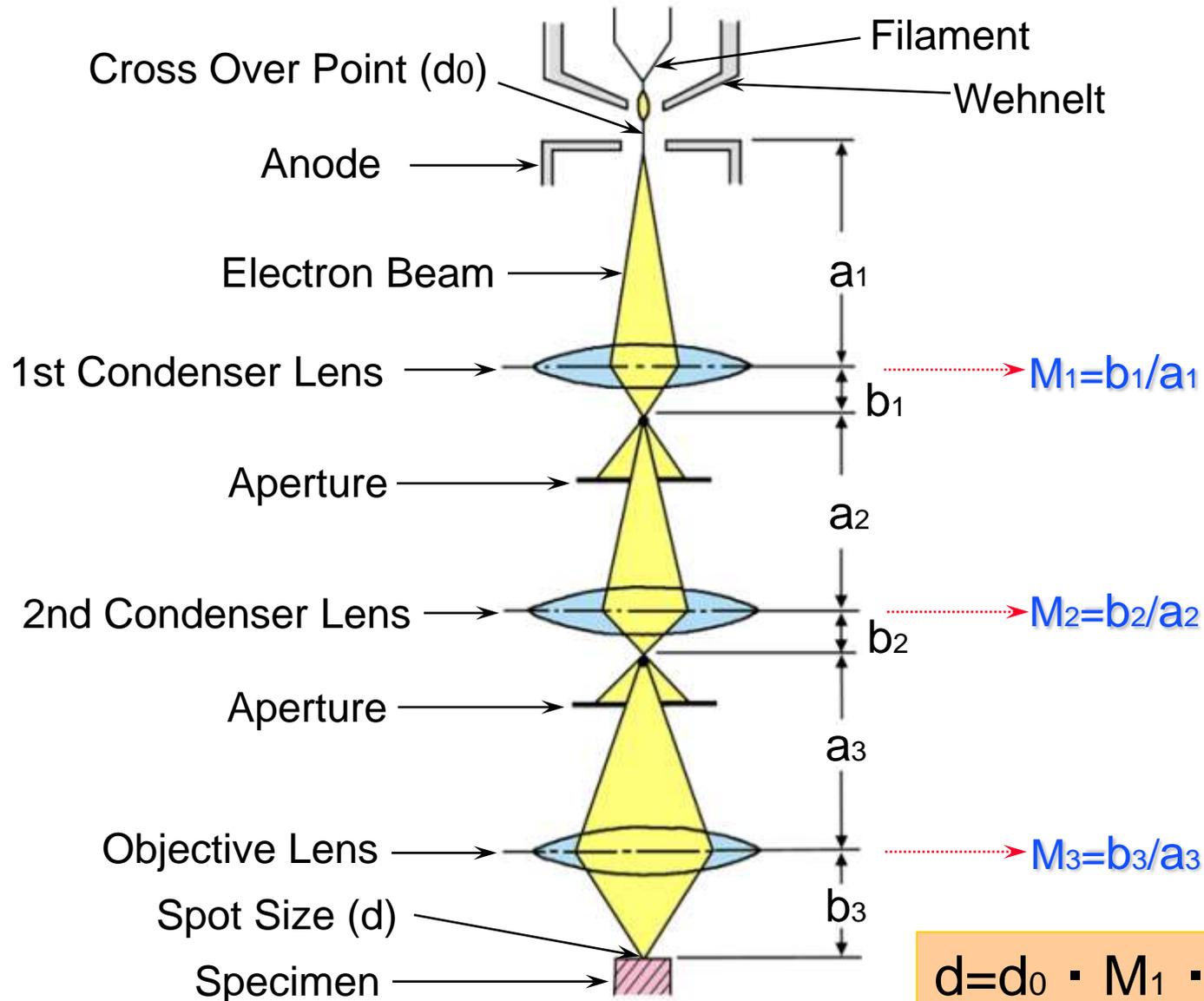
Resolution of SEM = the minimum recognizable distance between two particles

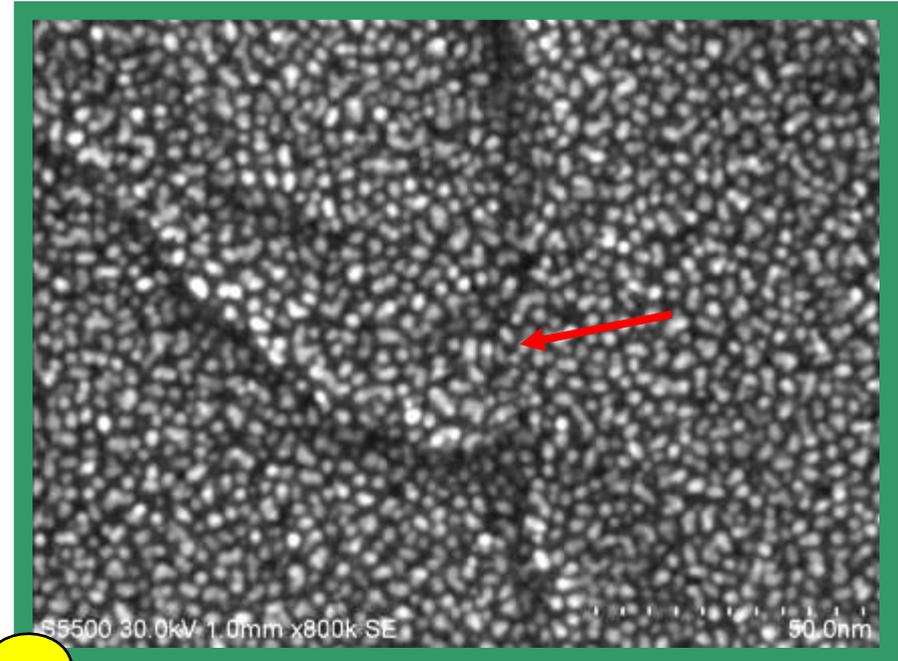
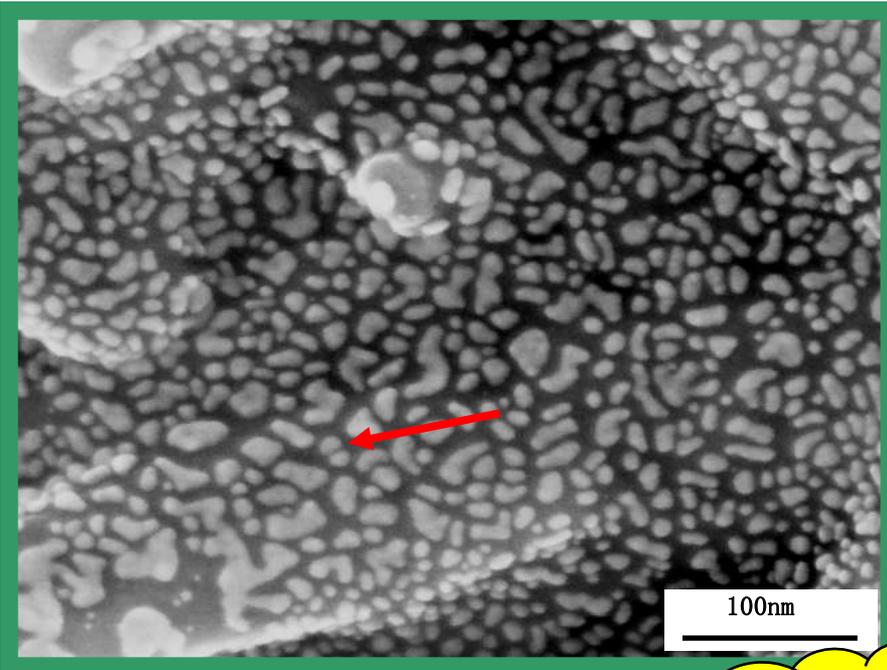


unrecognizable



recognizable





S-4800

Specimen : Pt particles

Vacc : 15kV

Mag. : 220kX

Resolution : 1.0nm

Base on
4x5 inch
film

S-5500

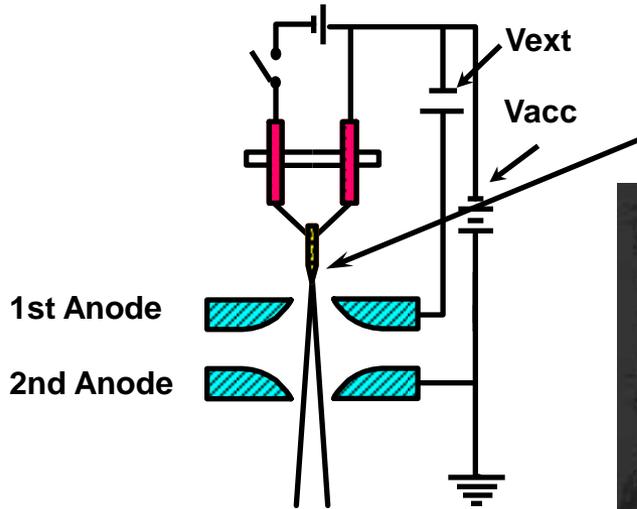
specimen : Pt particles

Vacc : 30kV

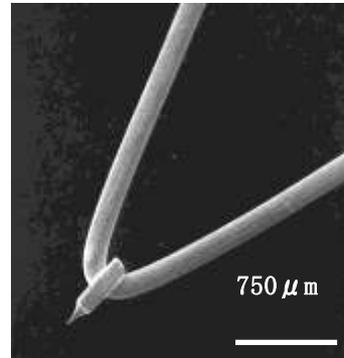
Mag. : 800kX

Resolution : 0.4nm

Flashing Power

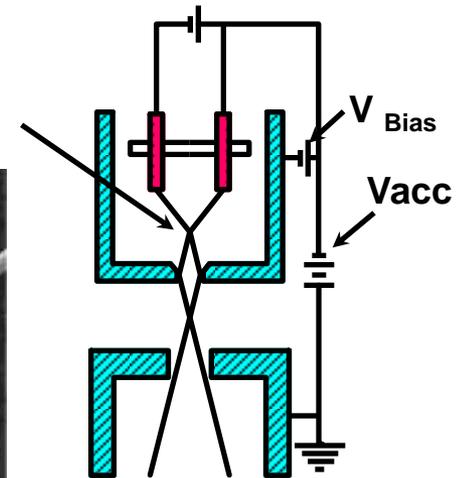


FE SEM Tip

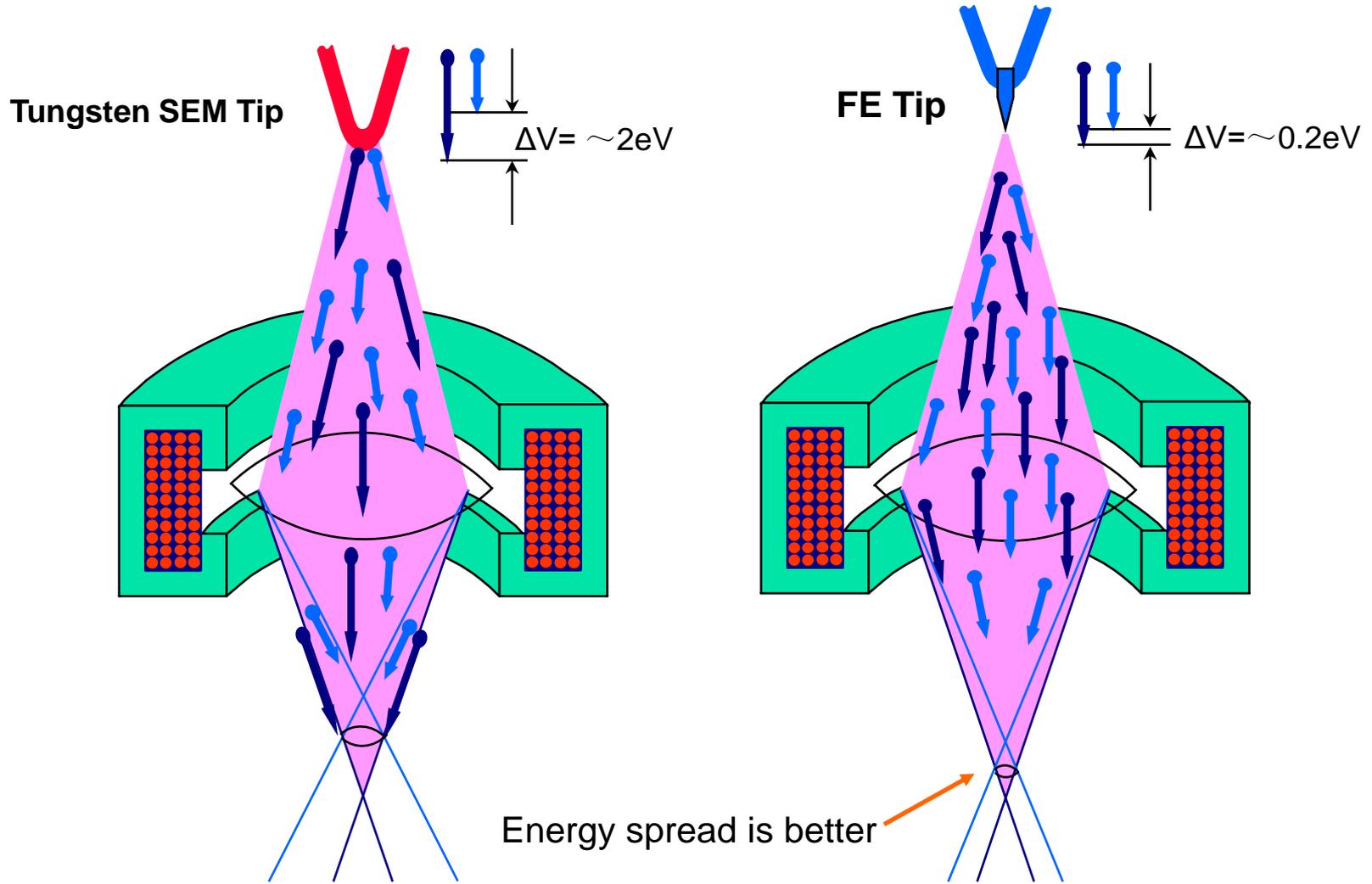


FE SEM

Tungsten SEM Tip



Tungsten SEM

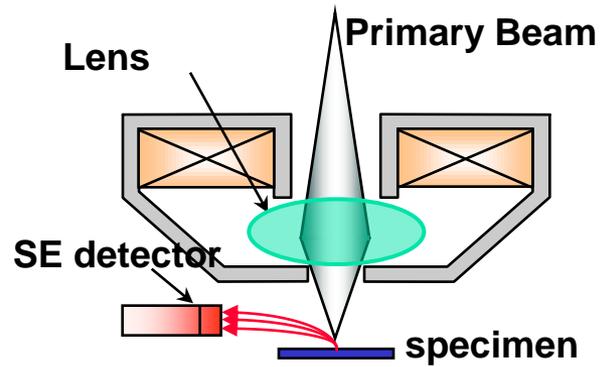


	Tungsten	LaB₆	Schottky	Cold FE
Electron Size	30μ	10μ	20nm	5nm
Luminance (A/cm ³ ·sr)	10 ⁶	10 ⁷	10 ⁸	10 ⁹
Energy spread (eV)	2	1.5	0.5~1	0.2~0.5
Cathode Temperature	2500	1800	1700~	room
Vacuum (Pa)	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁷
Life Time of Tip (hr)	50	100	5000	More than 1 year



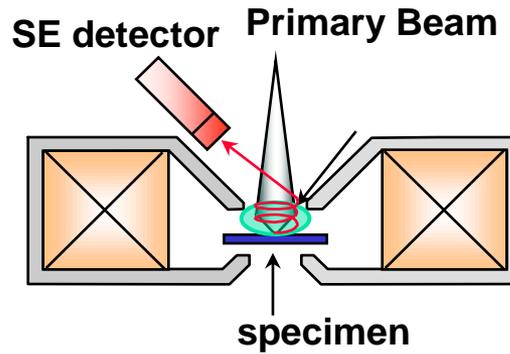
Range of use	Low Vacuum Surface structure observation WDX/EDX analysis CL/EBSD analysis Stable Ip of long time running	High resolution Low accelerated Voltage Observation WDX/EDX analysis CL/EBSD analysis Stable Ip of long time running CD-SEM (On line SEM)	Ultra high resolution Ultra low accelerated Voltage Observation EDX analysis Signal selection STEM
Series	S-2000 S-3000	S-4300SE/N CD-SEM	S-4000 S-5000
Resolution & Max Mag (for example)	3.0nm/x300k	1.5nm/x500k	0.4nm/x2000k

Out Lens



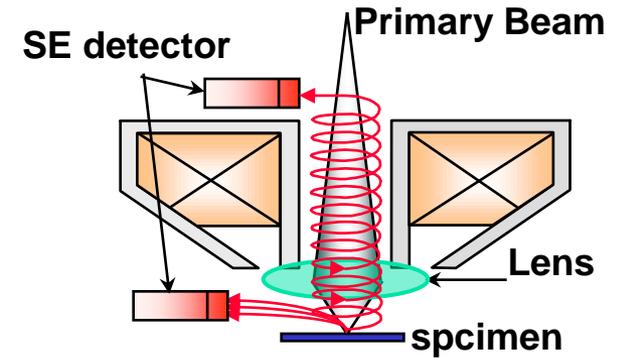
S-4300SE

In Lens

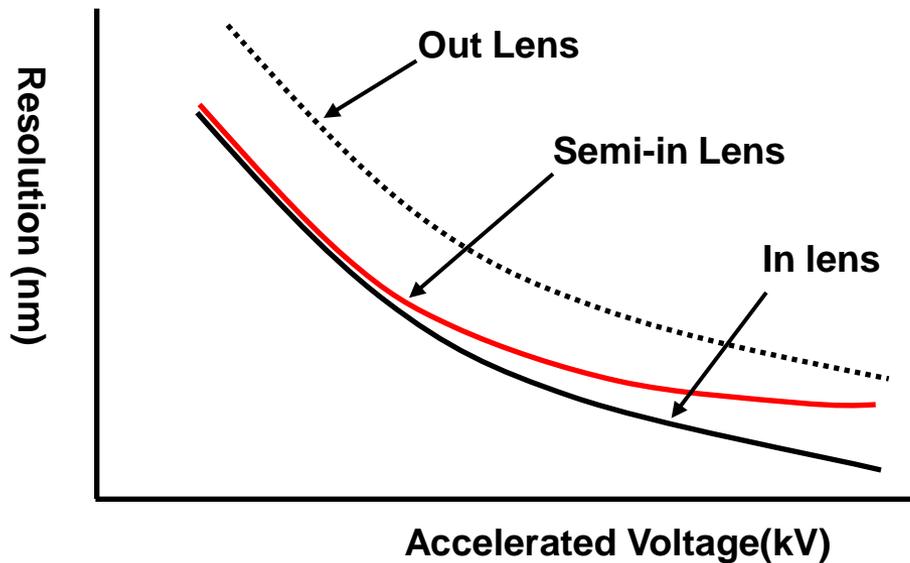


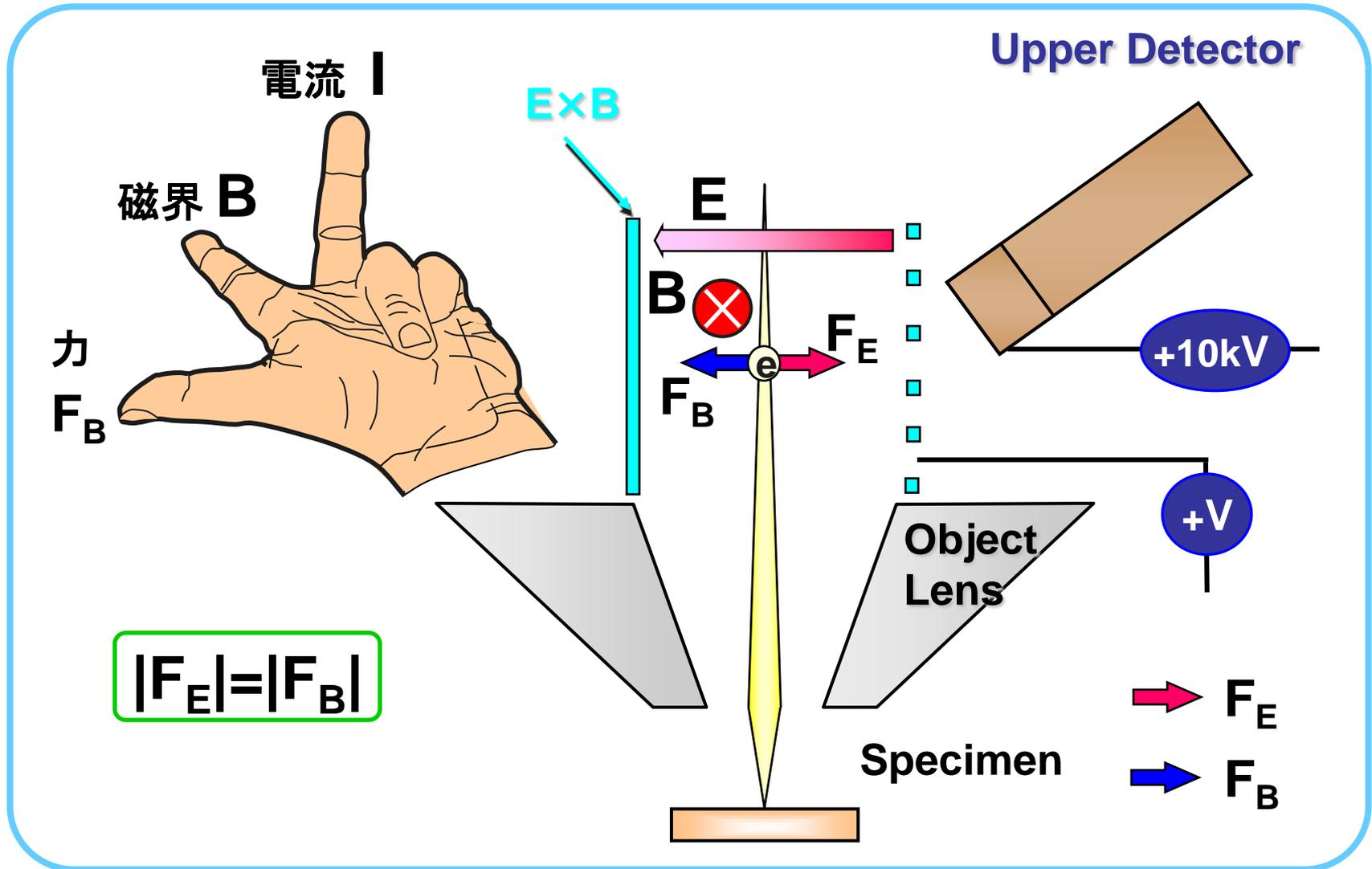
S-5200/S-5500

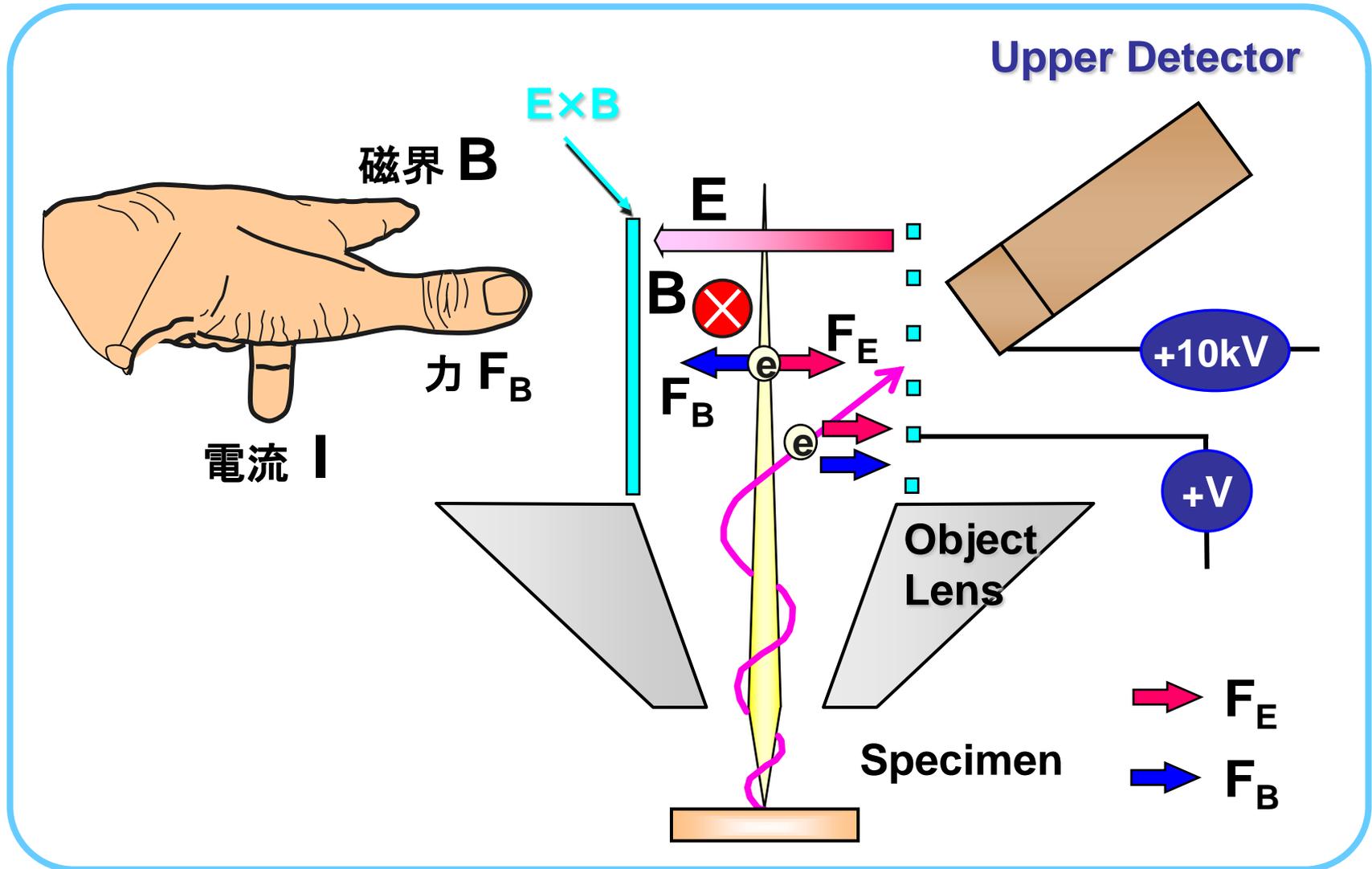
Semi-in Lens



S-4700/S-4800

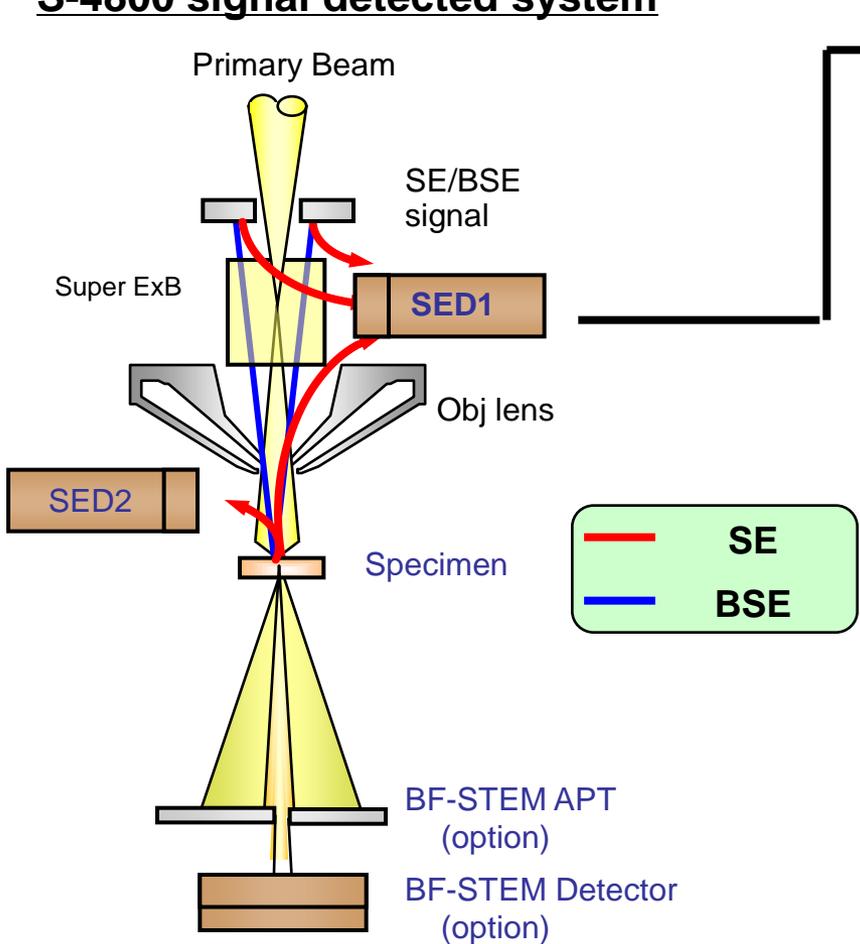






Multi signal detection

S-4800 signal detected system



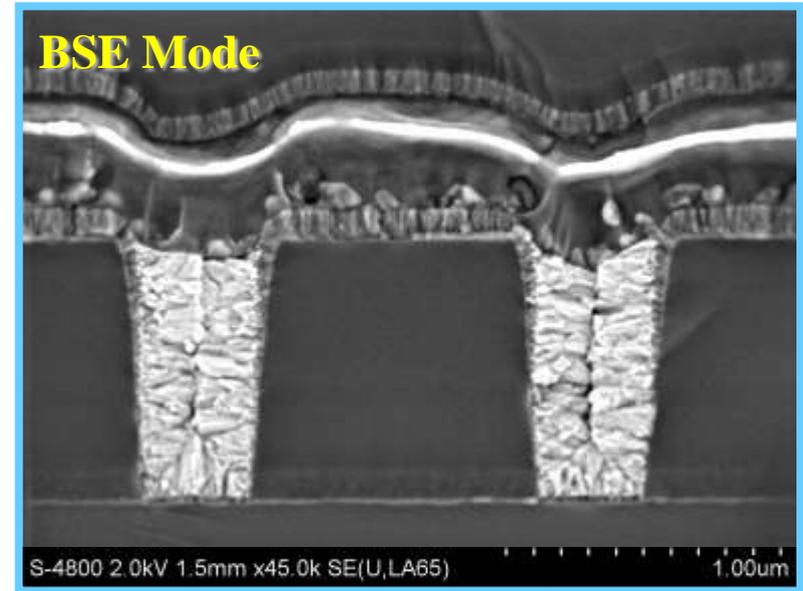
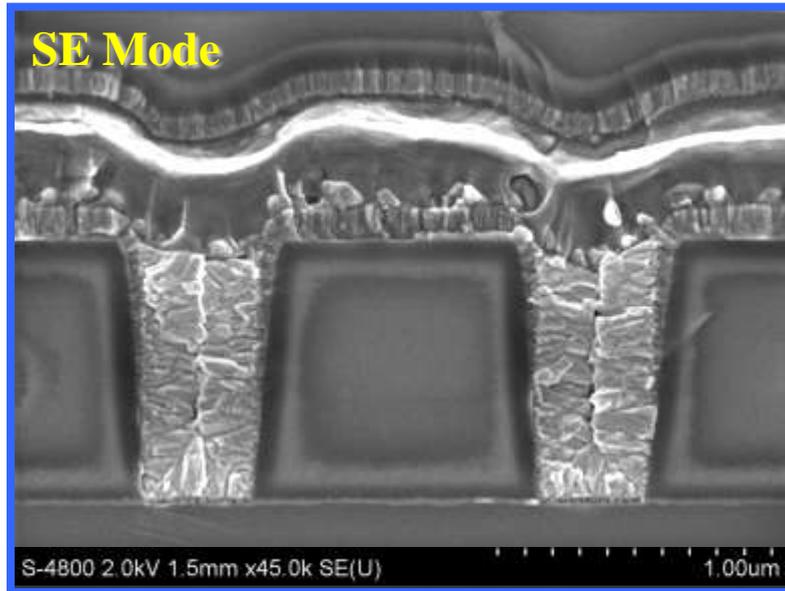
SE or SE+BSE-L

● SE

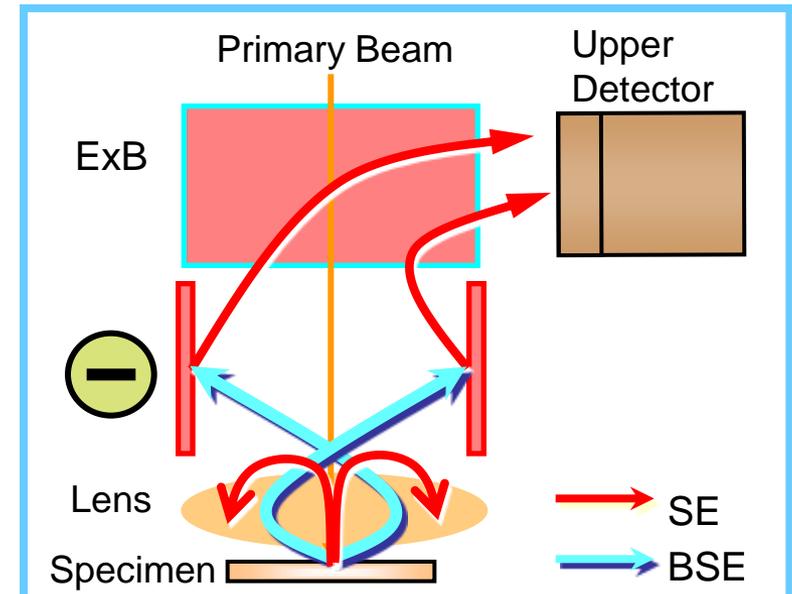
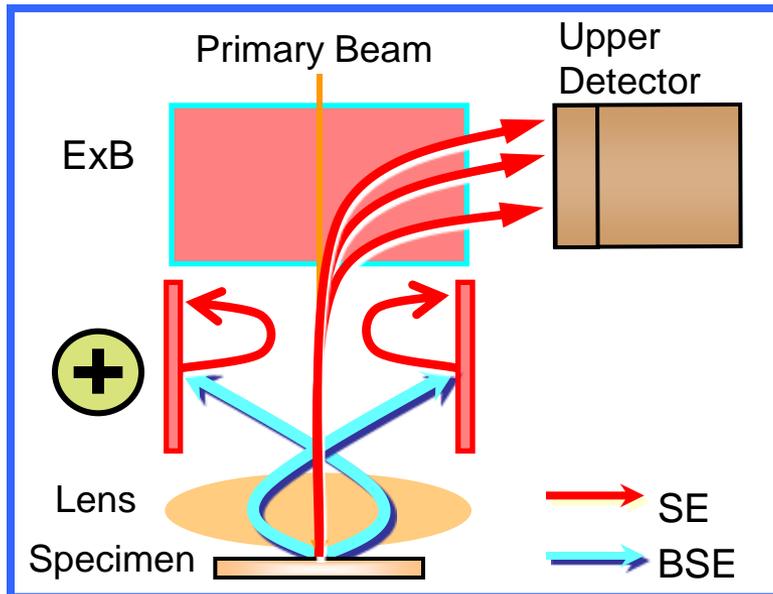
- Surface information
- High resolution
- easy to charge up
- energy :10 -100eV

● BSE

- composition information
- not easy to charge up
- less edge effect
- energy: depend on Vacc



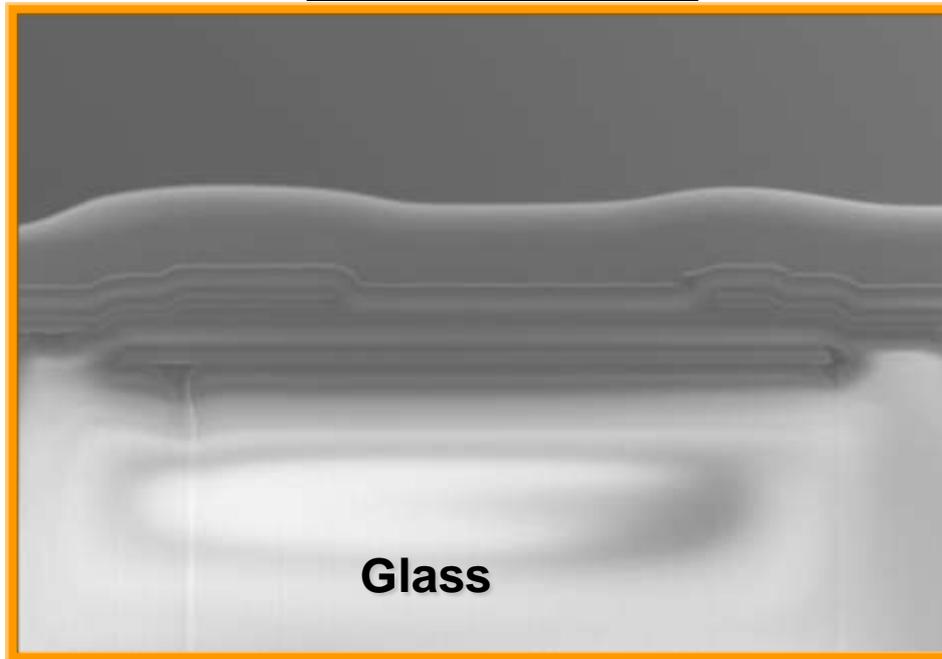
Al / W
Wire



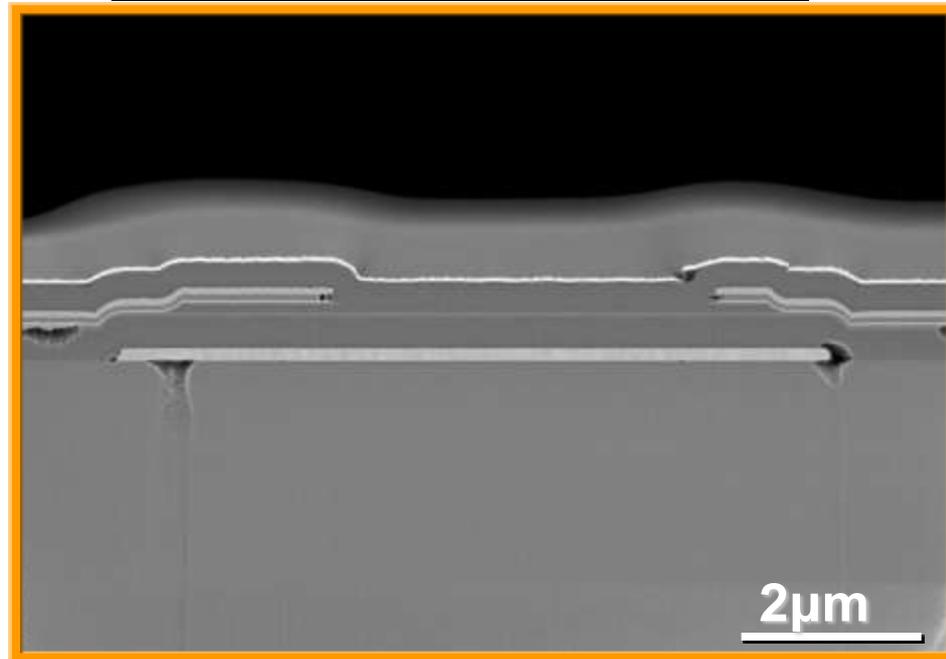
SE/BSE-L

S-4800

SE Mode



SE+BSE-L Mode



TFT(Thin Film Transistor)

Vacc : 2kV

Mag : ×12K

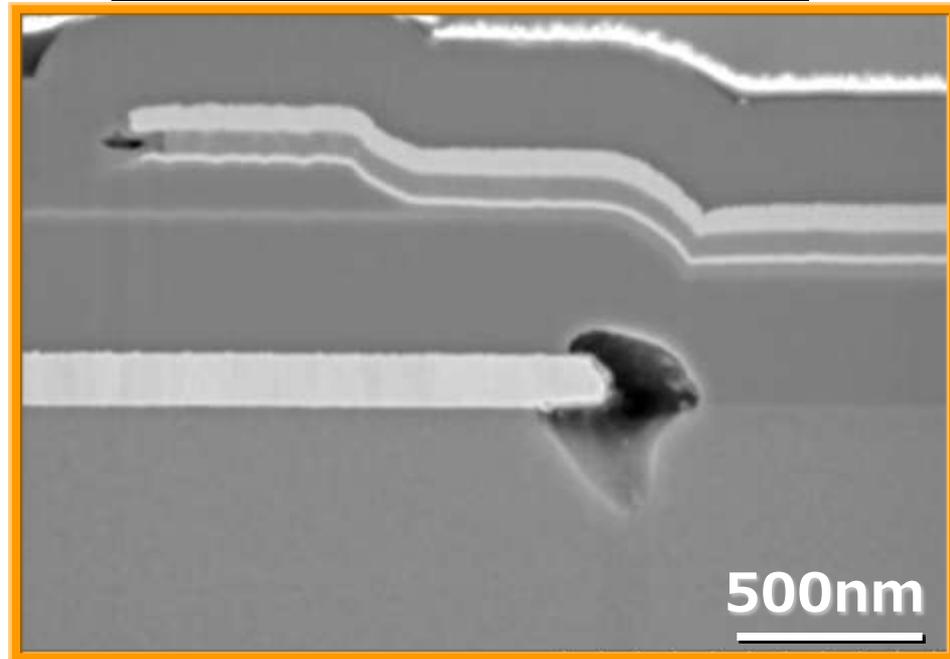
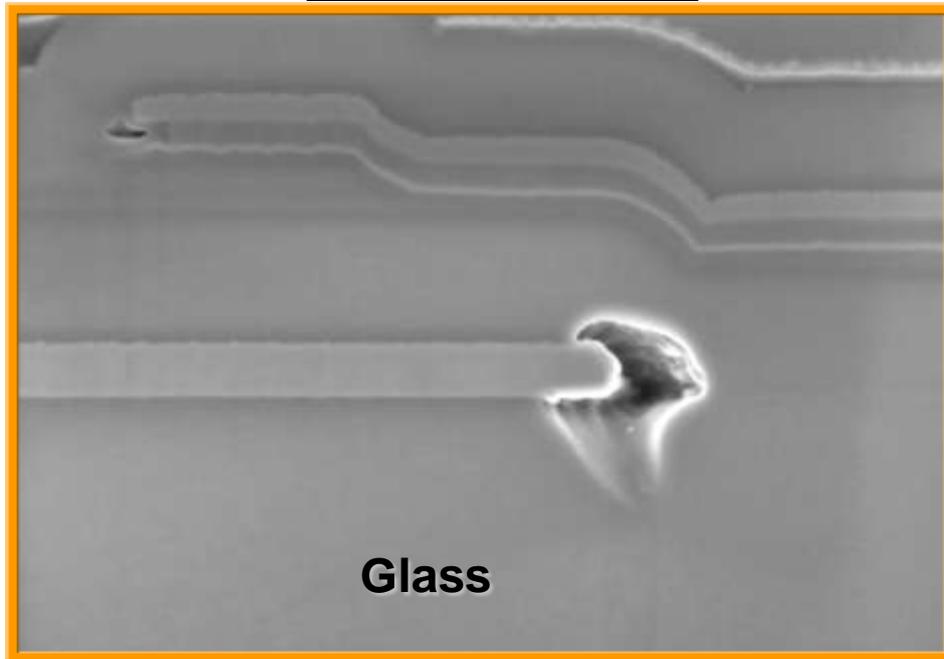
FIB, no coated

S-4800

SE/BSE-L

SE Mode

SE+BSE-L Mode



TFT(Thin Film Transistor)

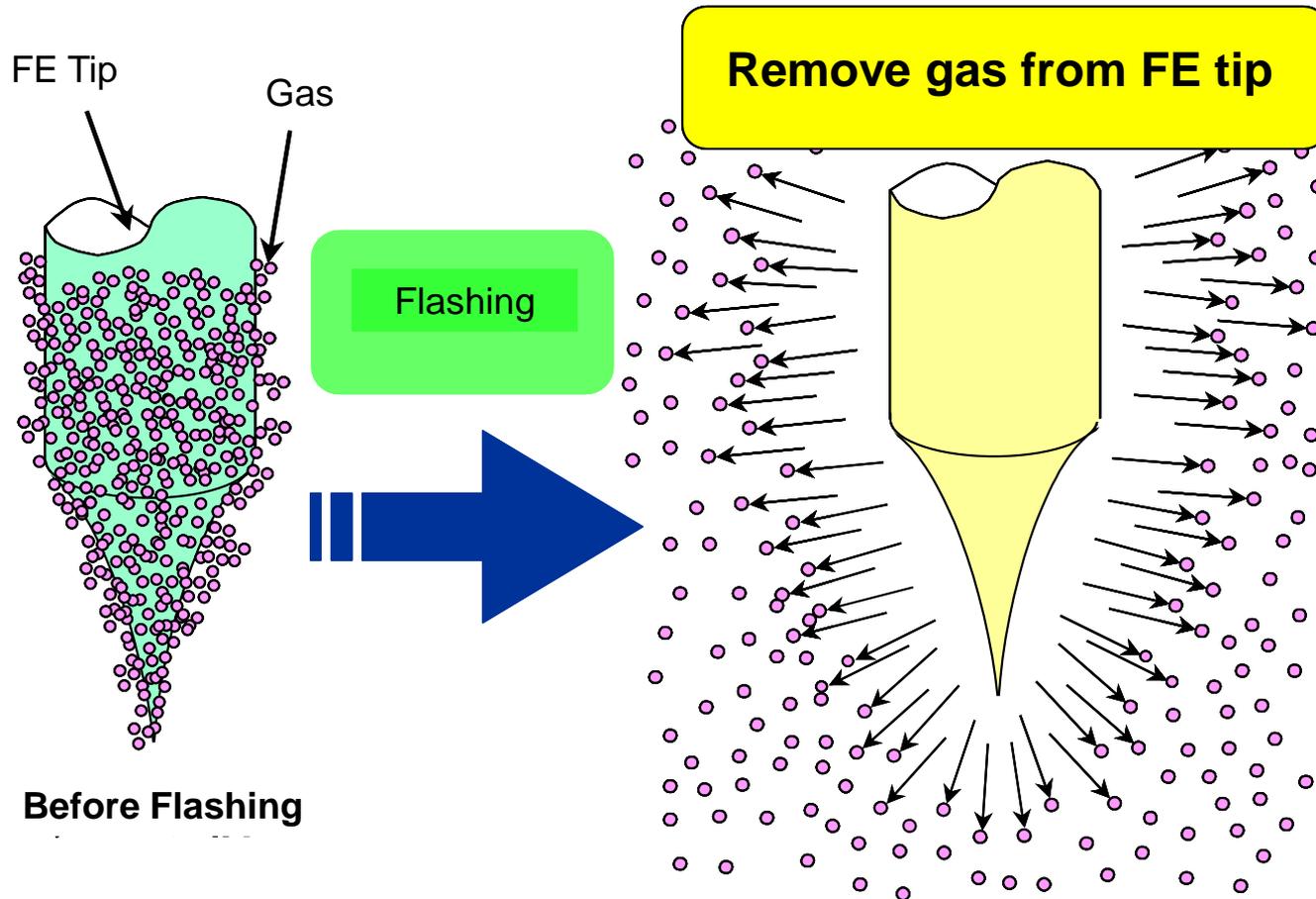
Vacc : 2kV

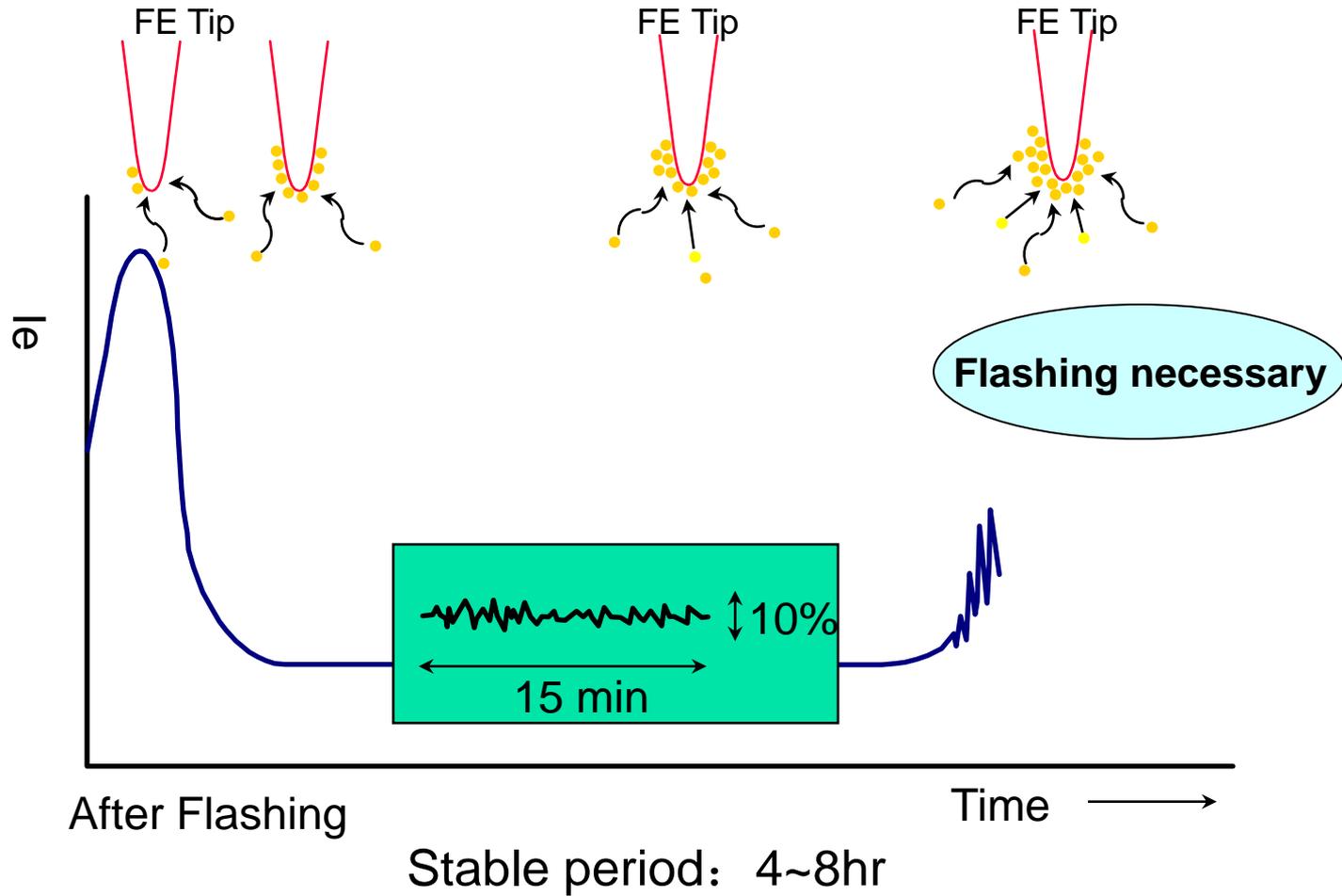
Mag : ×12K

FIB, no coated

	Vacuum (Pa)	Point	Hi-SEM	FE-SEM
机械泵 (Rotary Pump) (干泵 Dry pump)	$\sim 10^{-1}$	<ul style="list-style-type: none"> • 可以从大气压开始抽 • 有挥发油 (RP) <ul style="list-style-type: none"> • 无挥发油 (干泵) 	使用	使用
油扩散泵 (Diffusion Pump)	$10^{-3} \sim 10^{-6}$	<ul style="list-style-type: none"> • 价格底 · 耐用 • 震动少 • 有挥发油 • 需要前期抽真空装置 	使用	使用
分子泵 (Turbo Molecular pump)	$10^{-5} \sim 10^{-8} \text{ Pa}$	<ul style="list-style-type: none"> • 无油干净的真空 • 与DP相比, 比较贵 • 需要做一定的减震措施 • 需要前期抽真空装置 	使用	使用
离子泵 (Ion Pump)	$\sim 10^{-10} \text{ Pa}$	<ul style="list-style-type: none"> • 可以达到超高真空 • 无震动 • 需要前期抽真空装置 		使用

The function of Flashing is to reflash the surface of FE tip





END