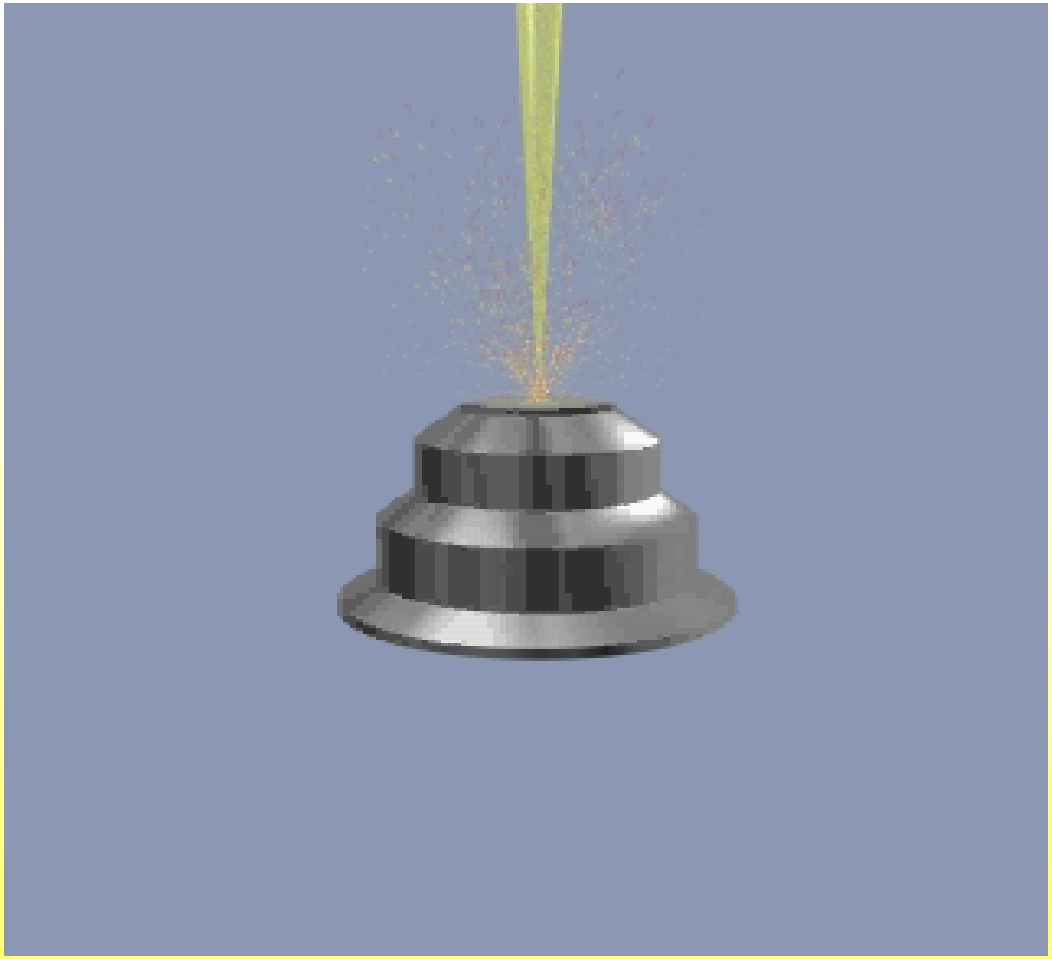
*E*nergy *D*ispersive *S*pectrometer (*X*-rays)

能量分散光譜儀



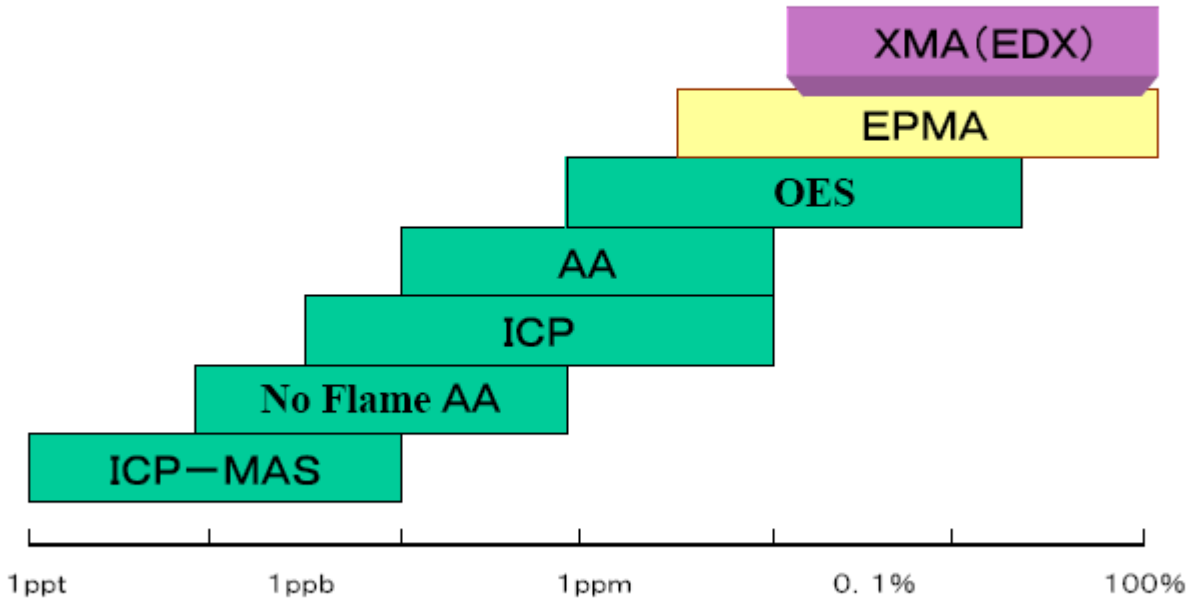
Theory of Energy Dispersive

表面分析技術一般性之比較

分析技術	典型應用	偵測元素	偵測極限	取樣深度	平面解析	影像/成像
AES	Surface Analysis & Depth Profile	Li – U Chemical binding	0.1 ~ 1 at%	5 ~ 50A	< 10nm	Y SEM/SAM
XPS	Surface Analysis & Depth Profile	Li – U Chemical binding	0.1 ~ 1 at%	5 ~ 75 A	< 10um	Y XPS mapping
SEM /EDS	Image & Elemental Microanalysis	B – U (EDS)	0.1 ~ 1 at%	1 ~ 5 um (EDS)	< 1nm	Y Y
FIB	Cross / thin section, IC Design, Modification	-	-	200 A	< 5nm	Y
XRD	Phase Identification		< 5%	> 600 A	5mm	
TXRF	Metal Contamination on Si wafer	S - U	10 E9 ~ E11 at/cm2	5nm	10mm	Y
RBS	Quantitative Thin Film Composition & Thickness	LI ~ U	10 - 1 - 0.01 - 0.001 at% (Z: 20;70)	20 ~500A	2mm	Y
SIMS	Dopant & Impurity Depth Profile, Surface, Micro-analysis	H - U	10E12 ~ E16 at/cm3 (ppm ~ ppb)	50 ~ 300 A	< 500A	Y
SPM	Surface Imagine			0.1A	< 10A	Y

Theory of Energy Dispersive Spectrometer

Classification of elemental analyzer



Measurement range

Theory of Energy Dispersive

What can you do with EDX analysis

- ***Qualitative analysis***
  - Range : $_{5}Be \sim _{92}U$
- ***Quantitative analysis***
  - Quantitative analysis by XPP
  - Na or more : 0.2～0.3wt%　C : about 1wt%
- ***Mapping (DBC)***
  - Multi-element simultaneous mapping
  - Line analysis
  - Phase analysis
- ***Particle analysis by elements***

Theory of Energy Dispersive Spectrometer

Pre-treatment sample

Theory of Energy Dispersive

Fixation of a sample (powder)

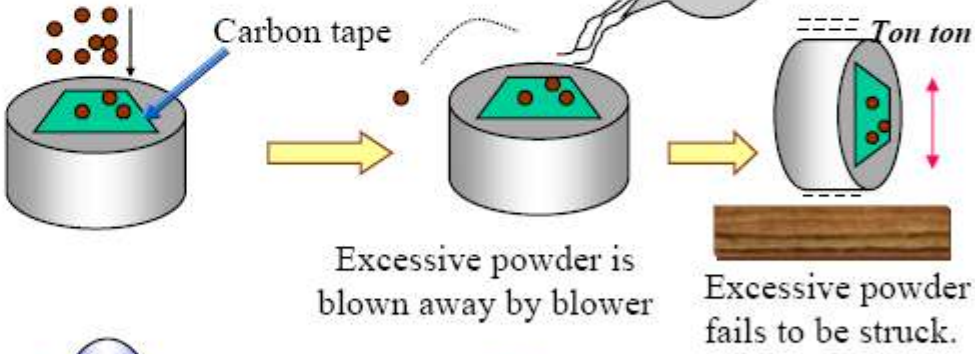
Sample holder Carbon product (For observation; Aluminum product)

The charge of sample fixed material Carbon tape

For conductive processing Carbon paste Silver paste

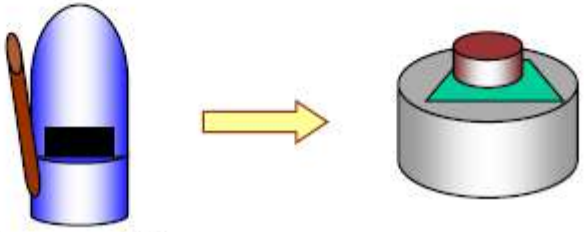
① The spatter method

It observes and analyzes in the state.



②The pressing method

It is suitable for the quantitative analysis.



Press machine

Theory of Energy Dispersive

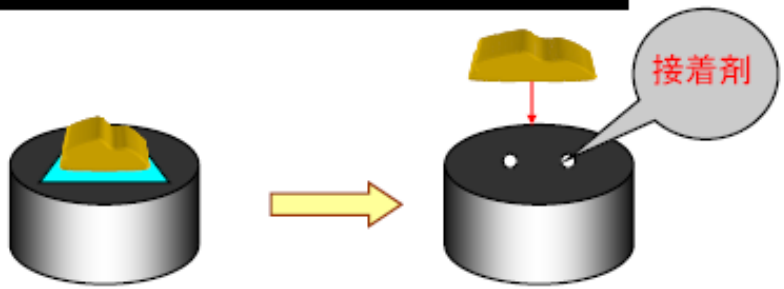
Fastening sample（massiveness sample）

Sample holder carbon

stuck material carbon tape

①Stuck as it is

（そのまま観察、分析）



元素ﾏｯﾋﾟﾝｸﾞする場合は接着剤で
確実に固定する

②buried in resin

（suitable for quantitative analysis）

超音波洗浄で
試料表面に残
っている研磨粉
を取り除く

試料を樹脂に埋め込む

鏡面研磨する（仕上げはﾀﾞｲｱﾓﾝﾄﾞﾍﾟｰｽﾄ等）

Theory of Energy Dispersive Spectrometer

Conductive processing of a sample

1. A sample with conductivity

> Especially this sample does not need a pretreatment.
>
> However, it is required between a sample and a sample holder to give conductivity at a carbon tape or carbon paste..

2. A sample without conductivity

> Carbon coating is performed to this in principle.
>
> Gold and platinum coating are performed to this by the case.

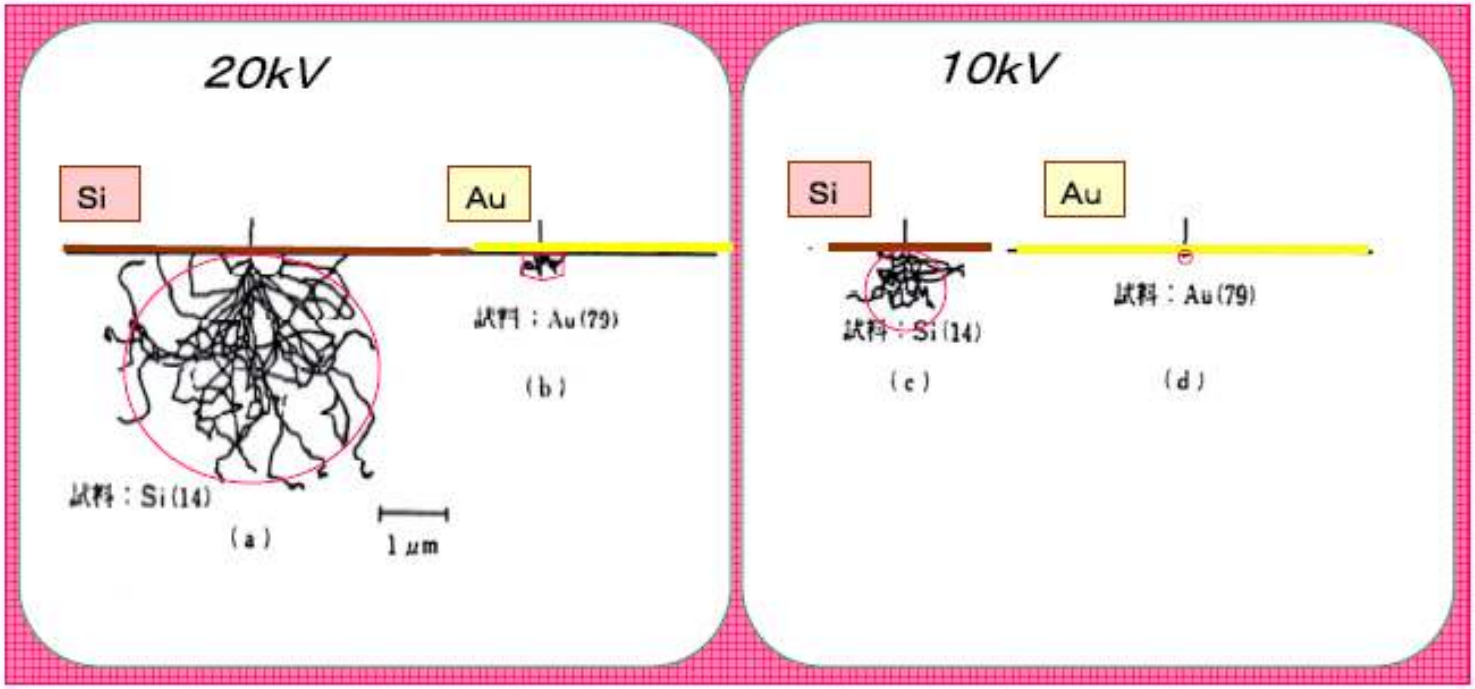
Theory of Energy Dispersive

Influence which the composition element of materials and the accelerating voltage has on the analysis depth

2196－6812－6/40

Although EDX analysis is called surface analysis, the X ray information in several micrometers depth is acquired on the average.

Deeper X ray information is acquired so that accelerating voltage is high, and, so that the average atomic number of a sample becomes low,.



Theory of Energy Dispersive

Coating

	Au／Pt	C
Image quality	○Good	△ No Good
分析	△X rays with small energy are absorbed in the coating layer	○As for X rays of all energy, absorption in the coating layer is little
	×There are overlap peak	

Theory of Energy Dispersive Spectrometer

Carbon, Gold, platinum Coating

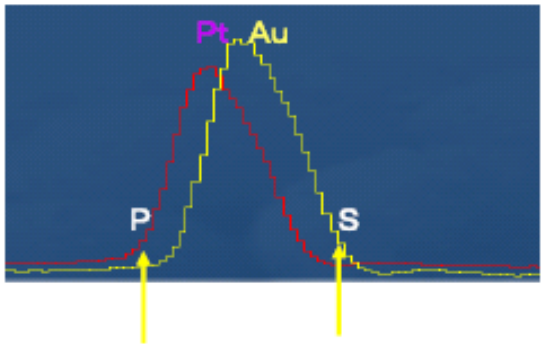
In general, when you observe SEM image ,you coat sample with Au,Pt.

But you analyze element.

①Characteristic X-ray generated from light elements absorbed by coating layer.

② P(phosphorus)and Sulfur peak overlap Gold,Platinum peak.

Carbon Coating

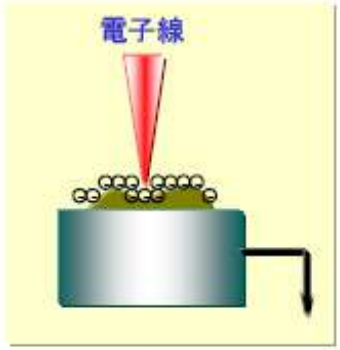


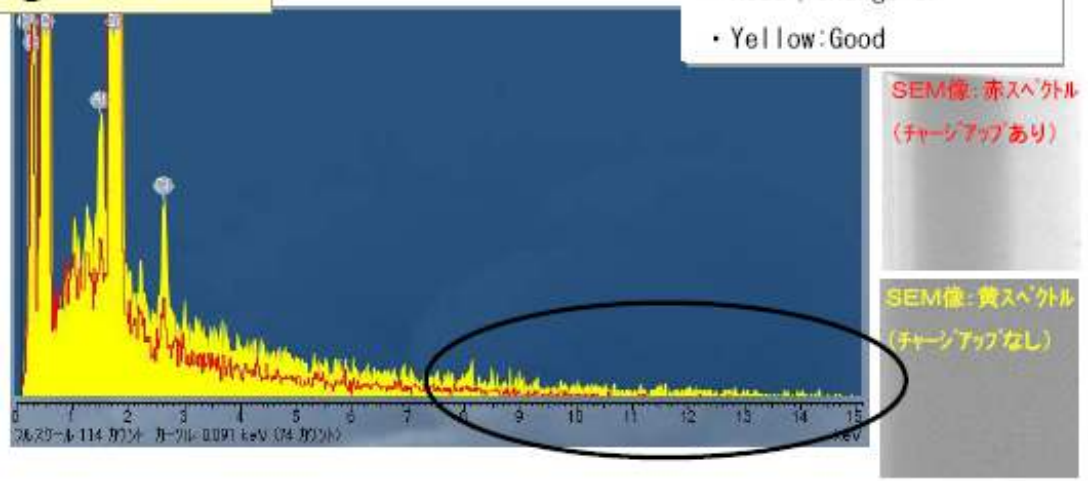
Theory of Energy Dispersive Spectrometer

2196－6812－20/4

Charge UP

Analysis : Not charge UP !!!



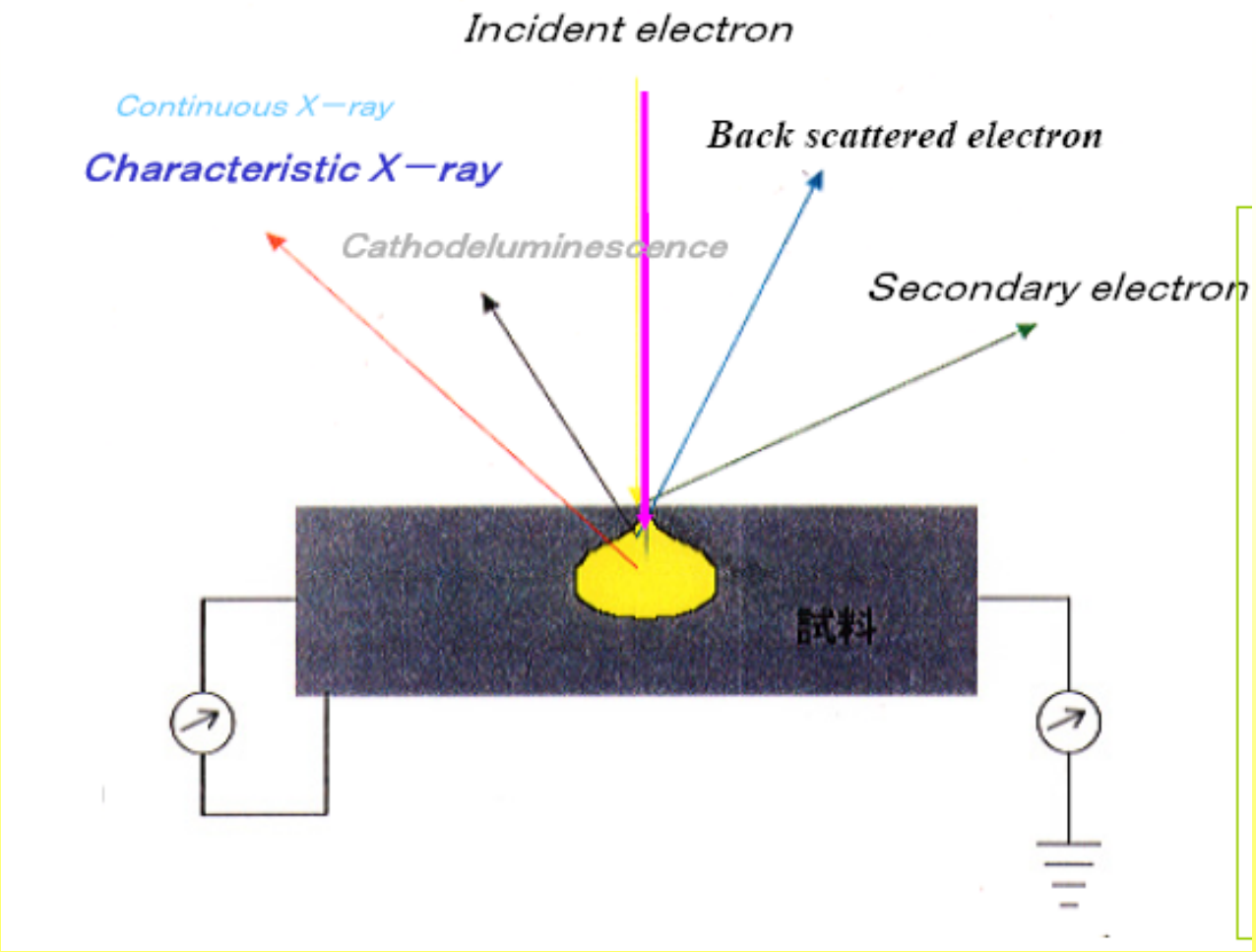


Theory of Energy Dispersive Spectrometer

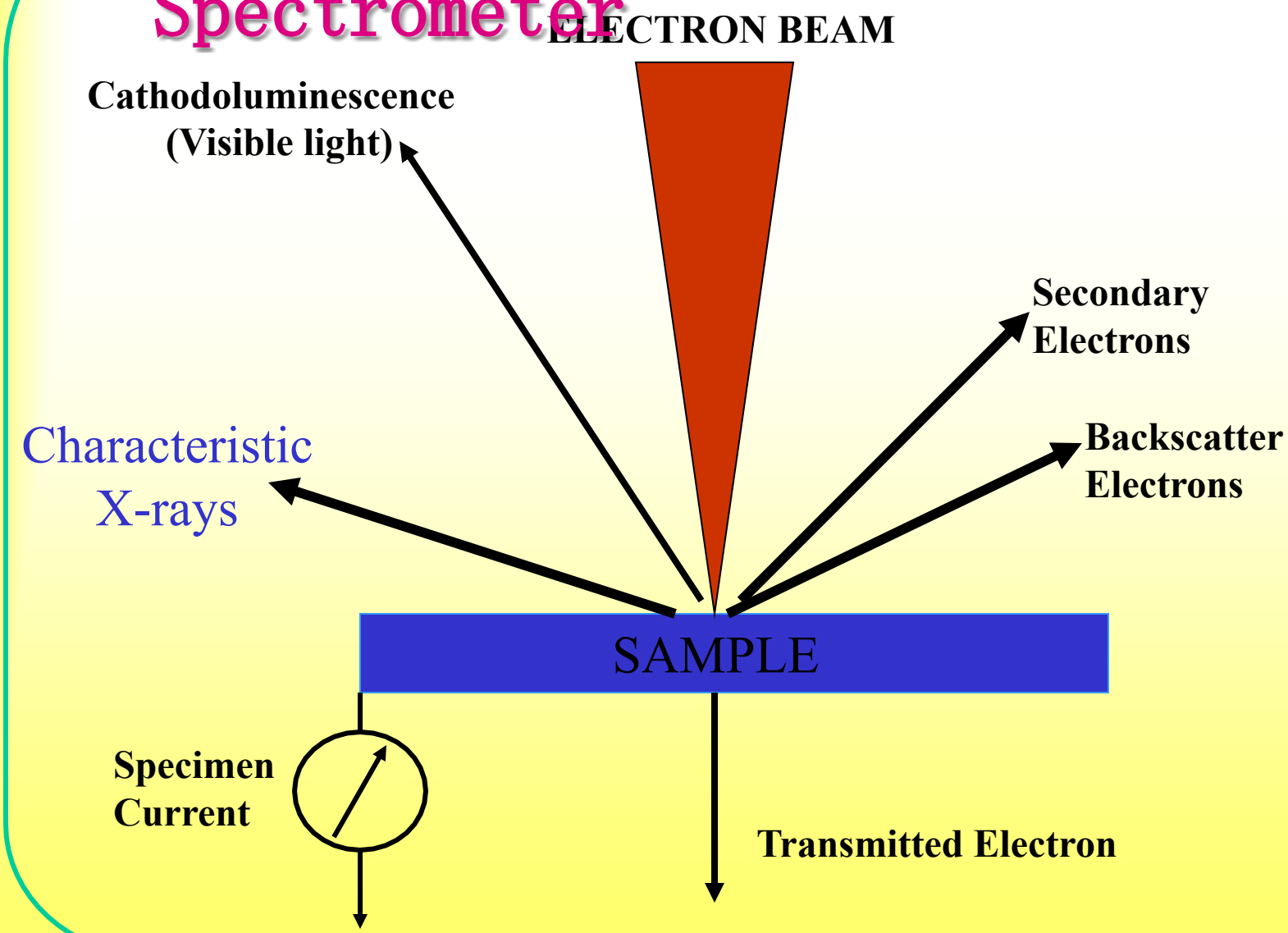
Principle of EDX

Theory of Energy Dispersive Spectrometer

Generation of X-ray



Theory of Energy Dispersive Spectrometer



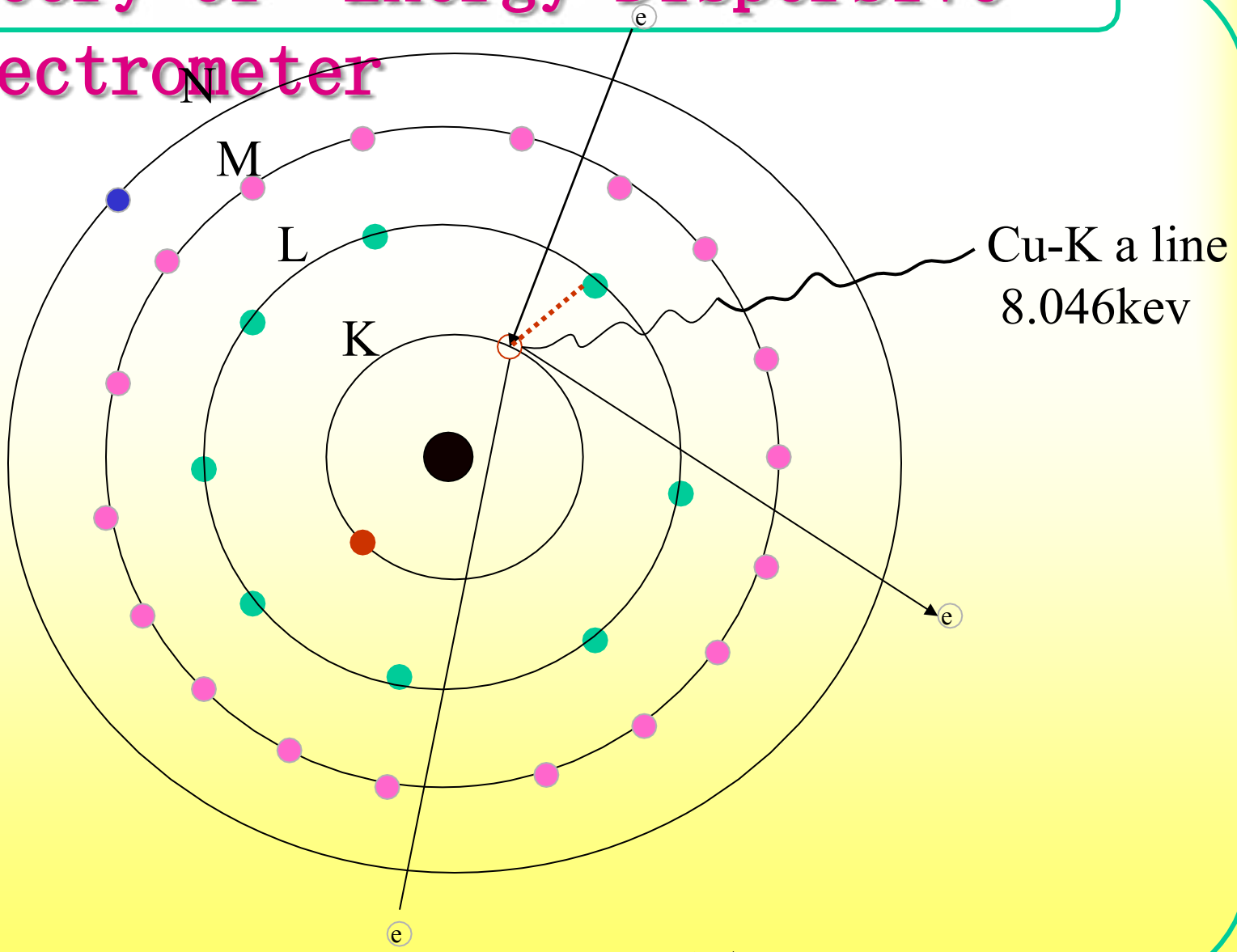
Theory of Energy Dispersive Spectrometer

●特性X-光(Characteristic X-rays)

產生機構

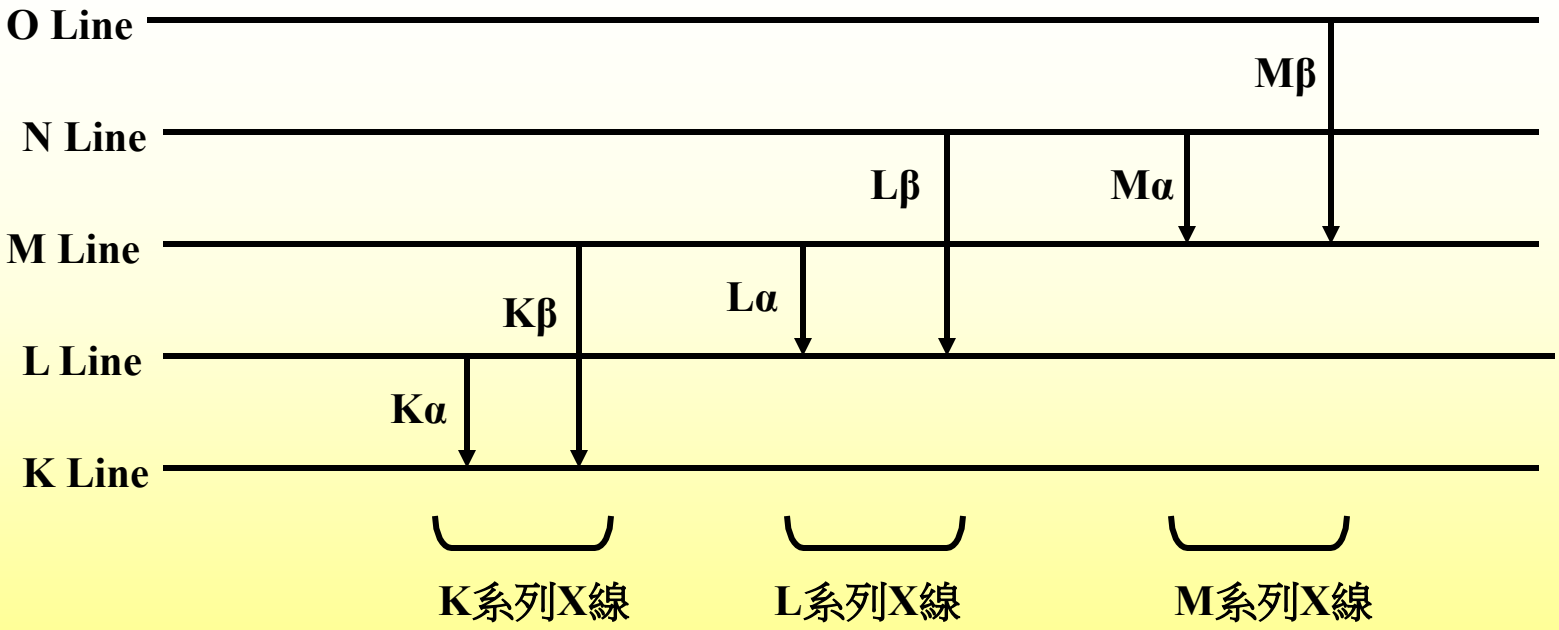
1. 電子或X-光激發原子內層電子
2. 外層電子填補空缺
3. 釋放出能量
4. 此能量激發出高階能階電子作為試片元素分析之依 據

Theory of Energy Dispersive Spectrometer

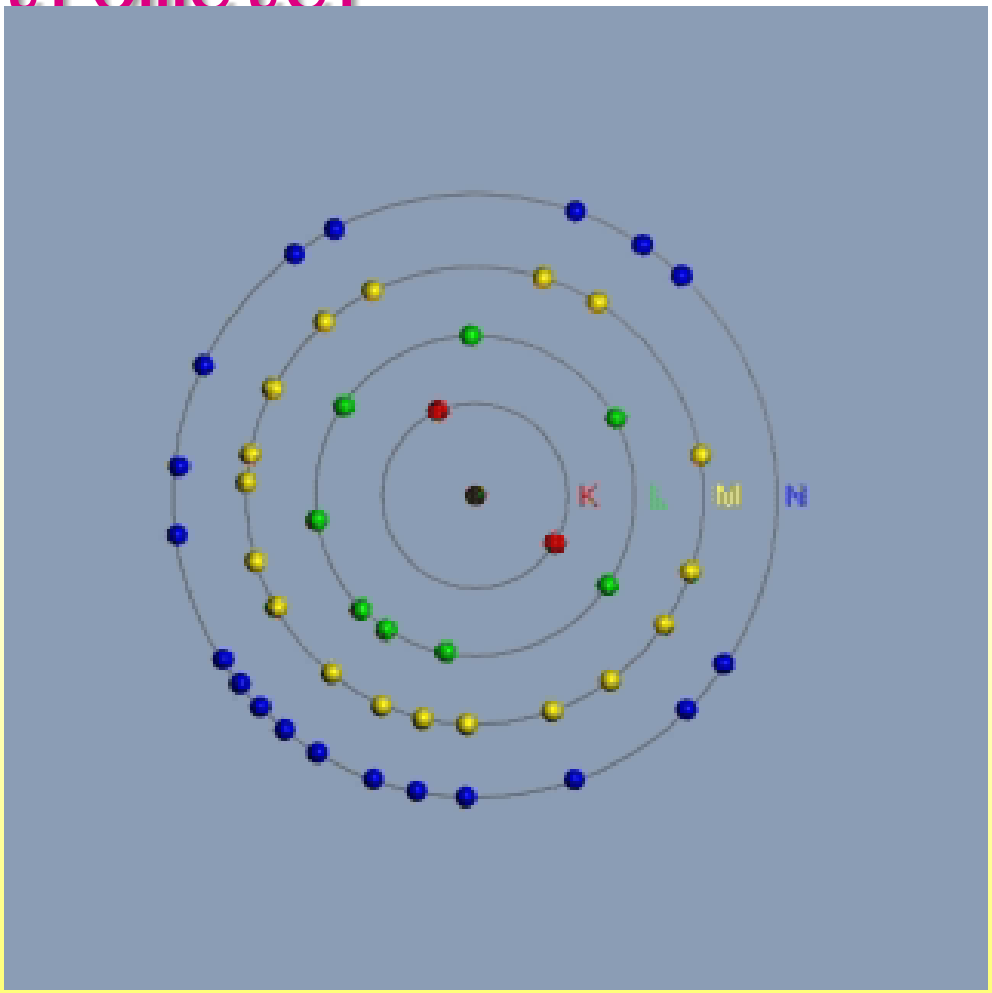


Cu (29) atom (原子)

Theory of Energy Dispersive Spectrometer



Theory of Energy Dispersive Spectrometer



K line energy production

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