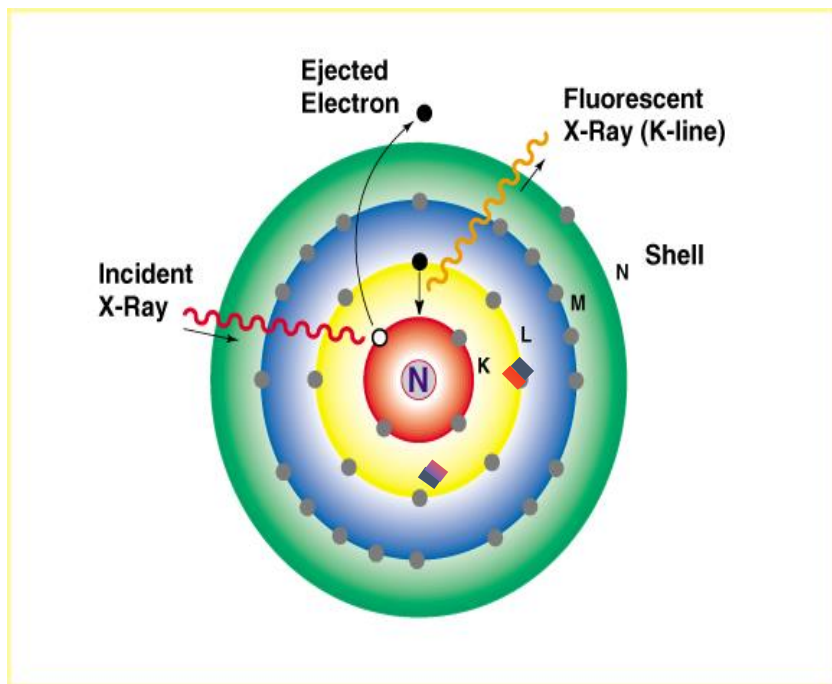


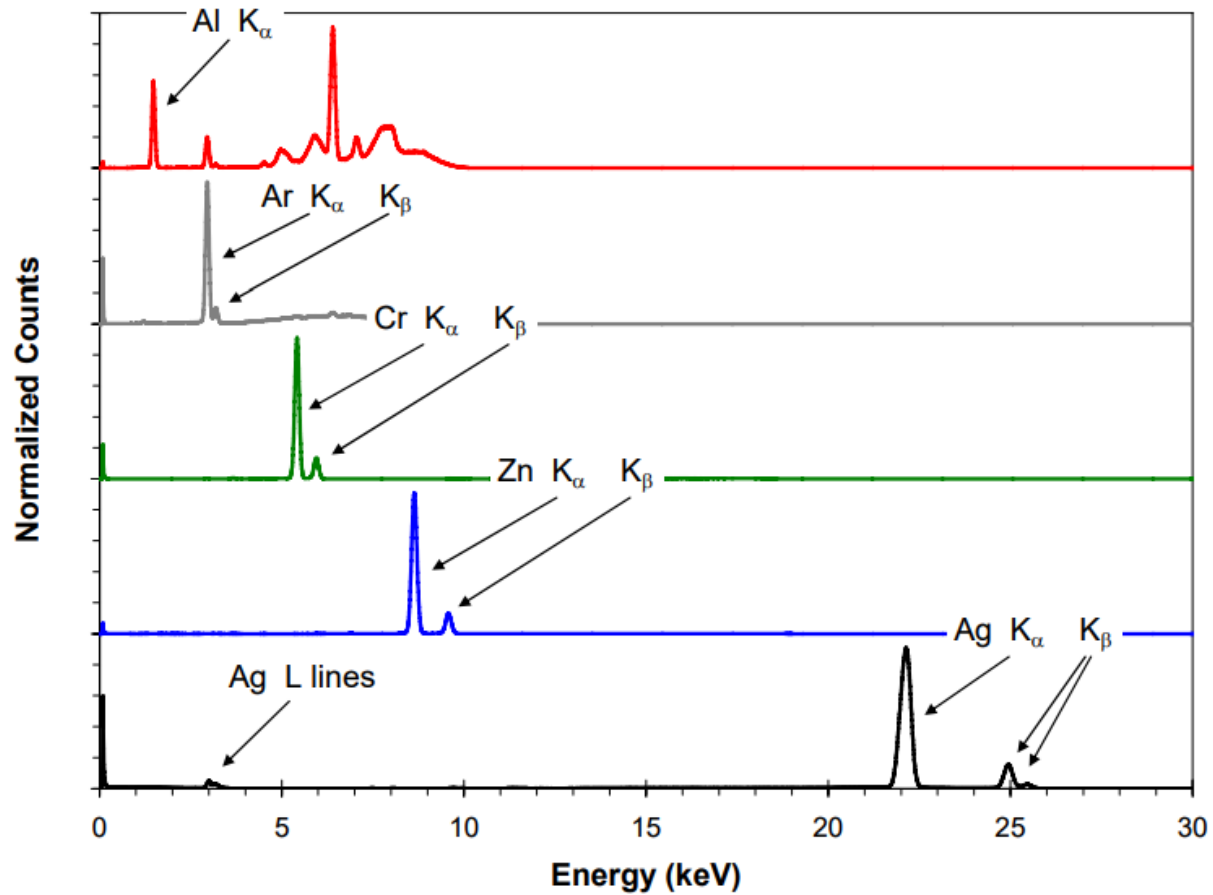
# X荧光的原理



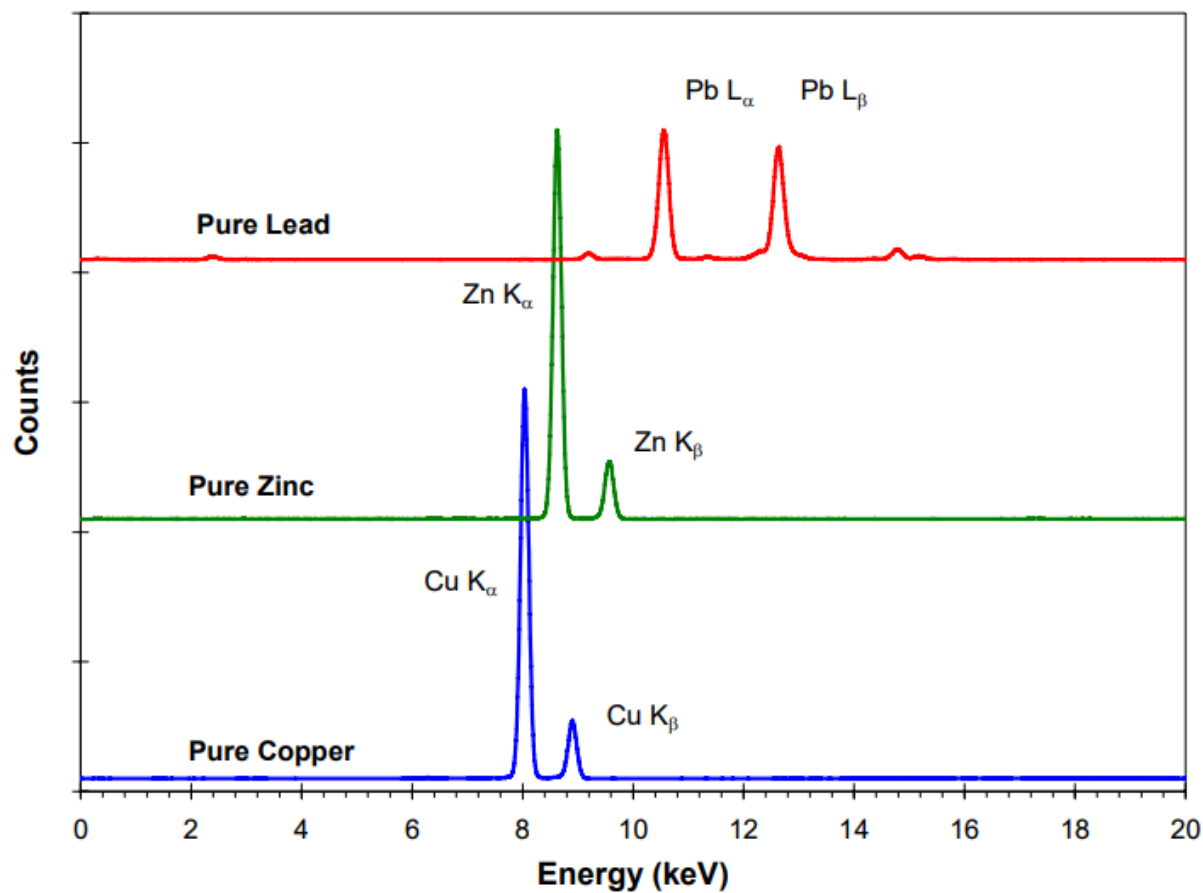
对被测样品发射一次X射线，样品的原子吸收X射线的能量后被激发并释放出二次X射线。

通过测量被释放出的二次X射线的特征能量和强度，就能够对被测样品的镀层厚度和成份进行定性和定量分析。

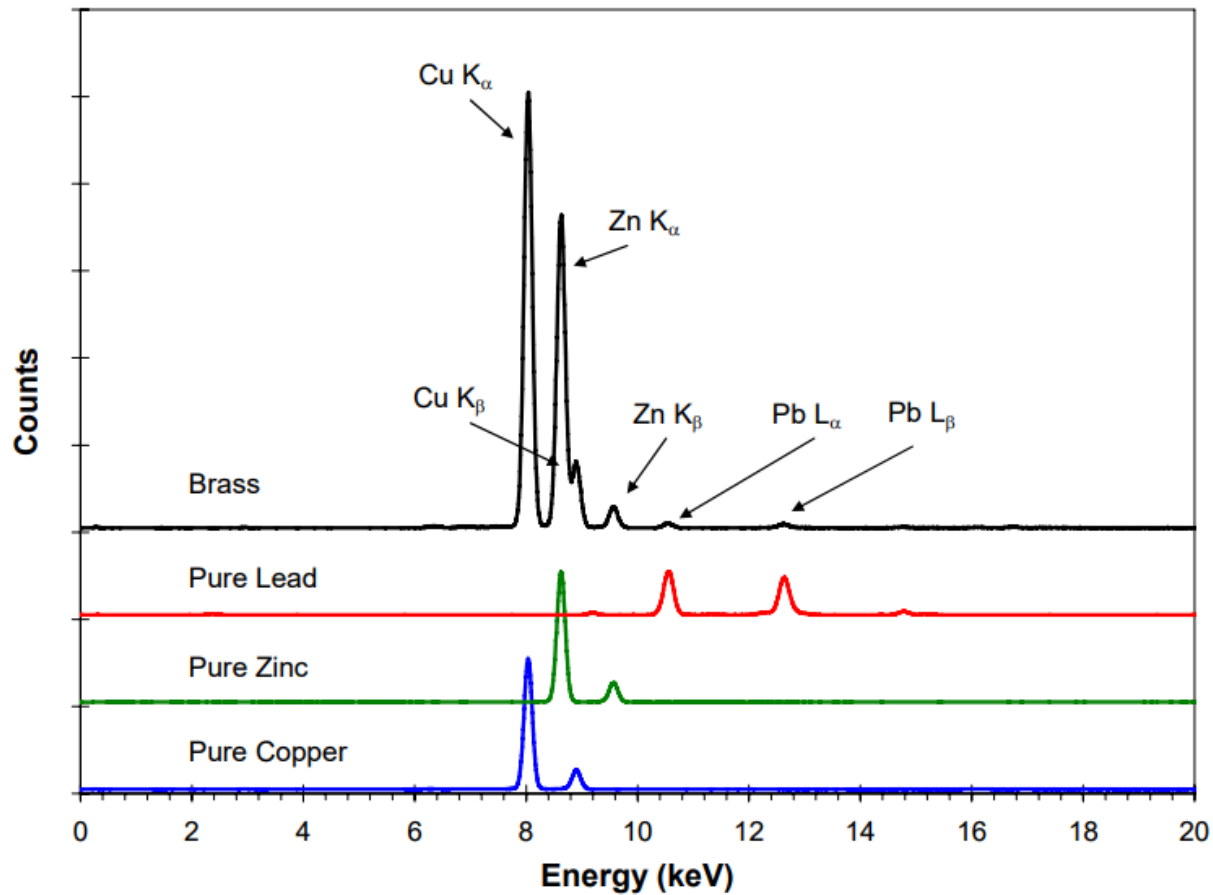
# 特征能量



# 纯金属的X荧光谱图



# 合金的X荧光谱图



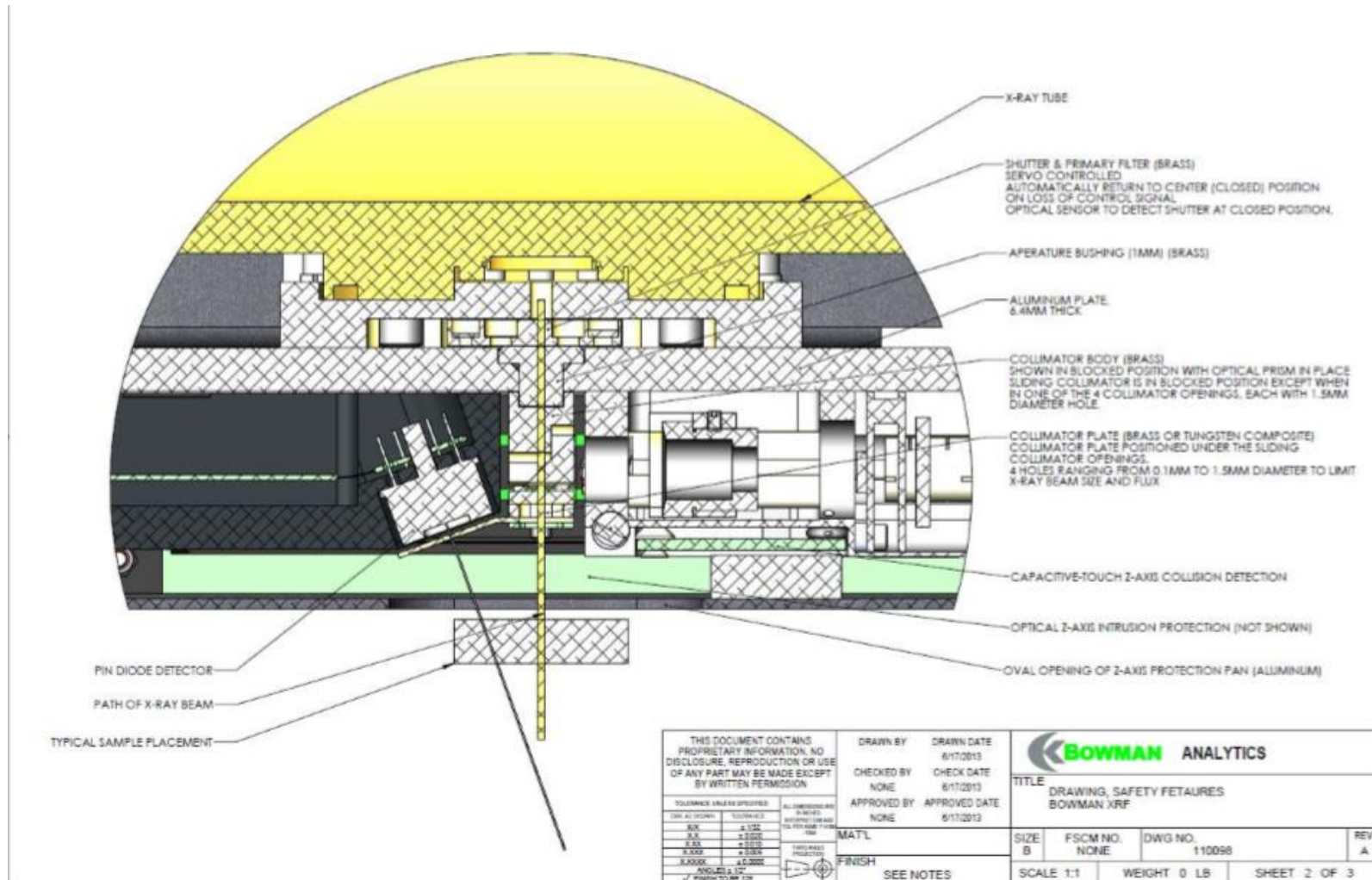
# X荧光定量分析方法

- Empirical 经验系数法

$$T = A I^B$$

- Fundamental parameters基本参数法

# X 荧光仪器系统



# 行业发展带来的新挑战

- Improved functionality
  - Phos analysis in electroless nickel
  - Alloyed plating
  - Solutions analysis
- Regulatory changes
  - Restriction of hazardous materials
- Tighter tolerance
  - Thinner coatings
  - Cost/material reduction
  - More thickness testing required
- Ongoing miniaturization of plated parts

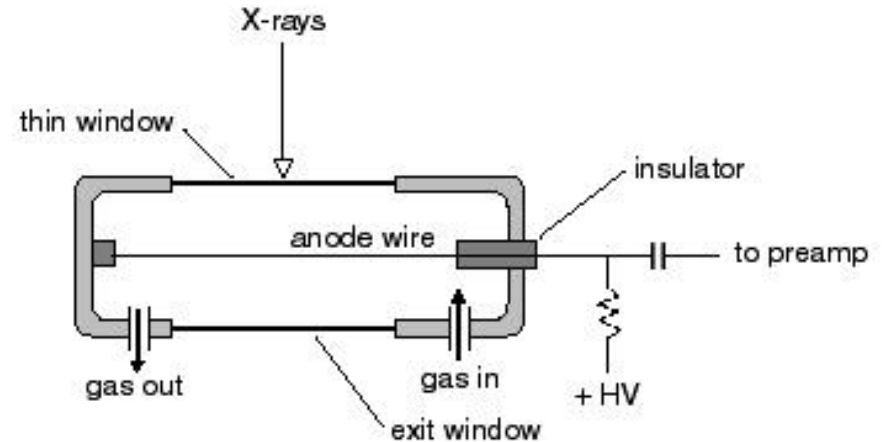
# X 荧光新技术

- Different types of detectors
  - Improved resolution
  - Improved stability
  - Prolonged life
- Various X-ray tube targets
  - Optimized for challenging applications
  - Cr, Mo, W, Rh, etc.
- X-ray optics
  - Poly capillary optics
  - Halo reduction optics
- Modular design
  - Miniaturized components
  - Low component cost
  - Better serviceability

# 检测器的发展

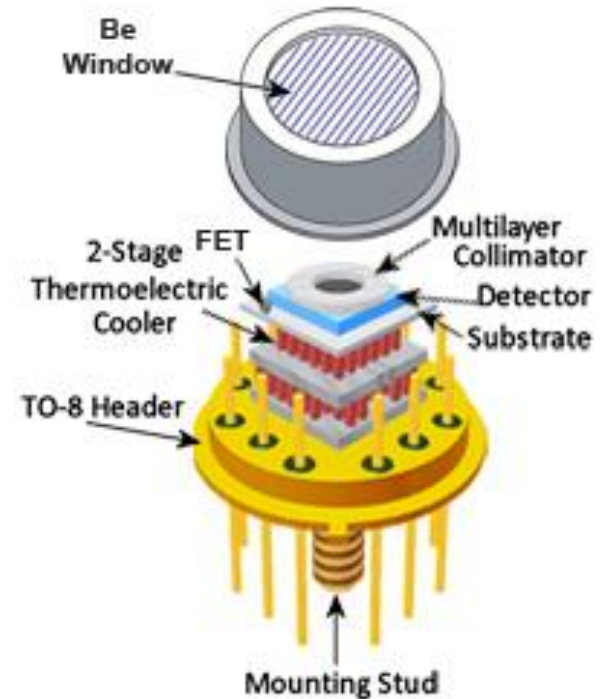
# 正比计数器

- Xe, Ne, or other halogen gas filled
- Drift with temperature or/and humidity change
- 10,000~30,000 cps
- 800~1200eV at Mn resolution
- Shorter life (2~5 years)



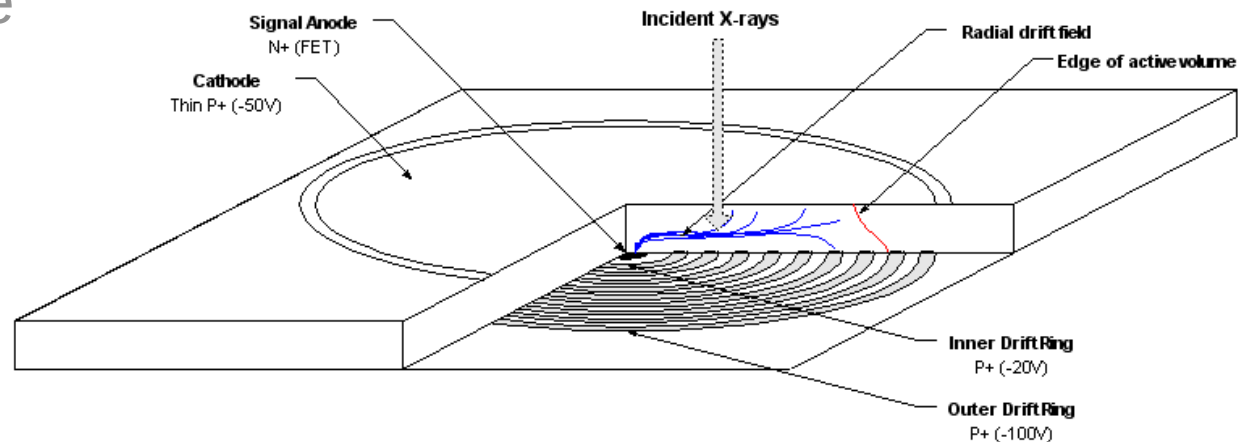
# PIN 检测器

- Thermoelectrically cooled (Peltier)
- Be window
- Count rates:  
3000~50,000 cps
- Resolution:  
170~240eV at Mn K  $\alpha$
- 10+ years life

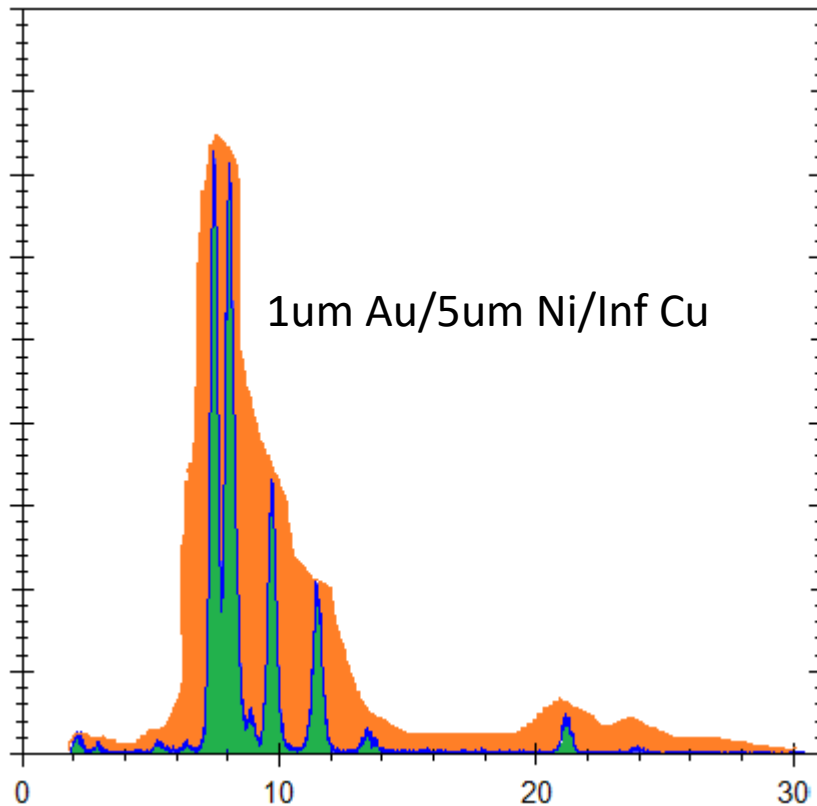


# 硅漂移检测器 (SDD)

- Thermoelectrically cooled (Peltier)
- Be window or Carbon based material
- Light element capability (i.e. P, Si, Al)
- Count rates: 10,000~1,000,000 cps
- Resolution: 120~170eV at Mn K a
- 10+ years life



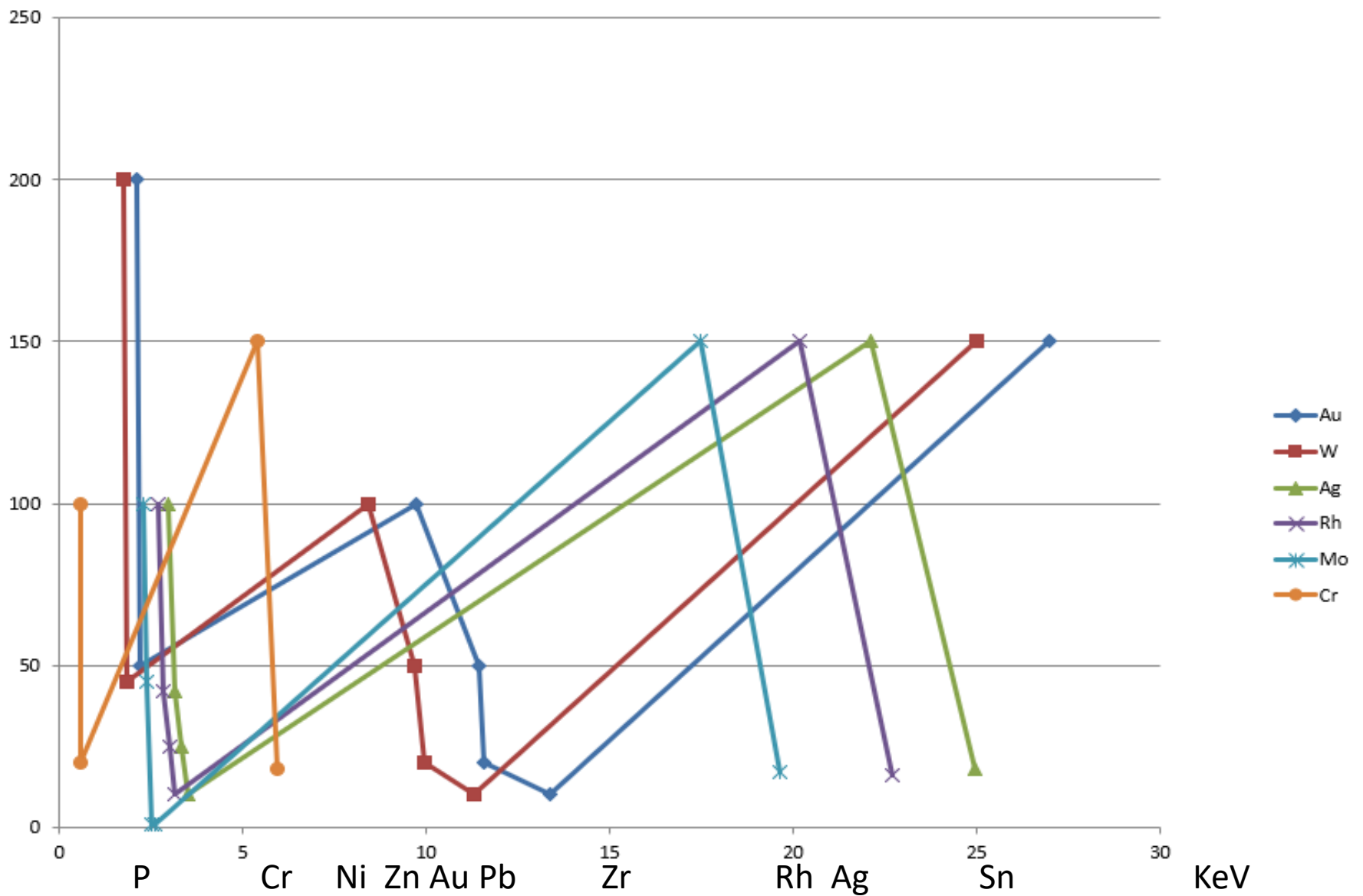
# 固态检测器的优点



Orange=Gas-filled proportional counter detector  
Green=Si PIN diode detector

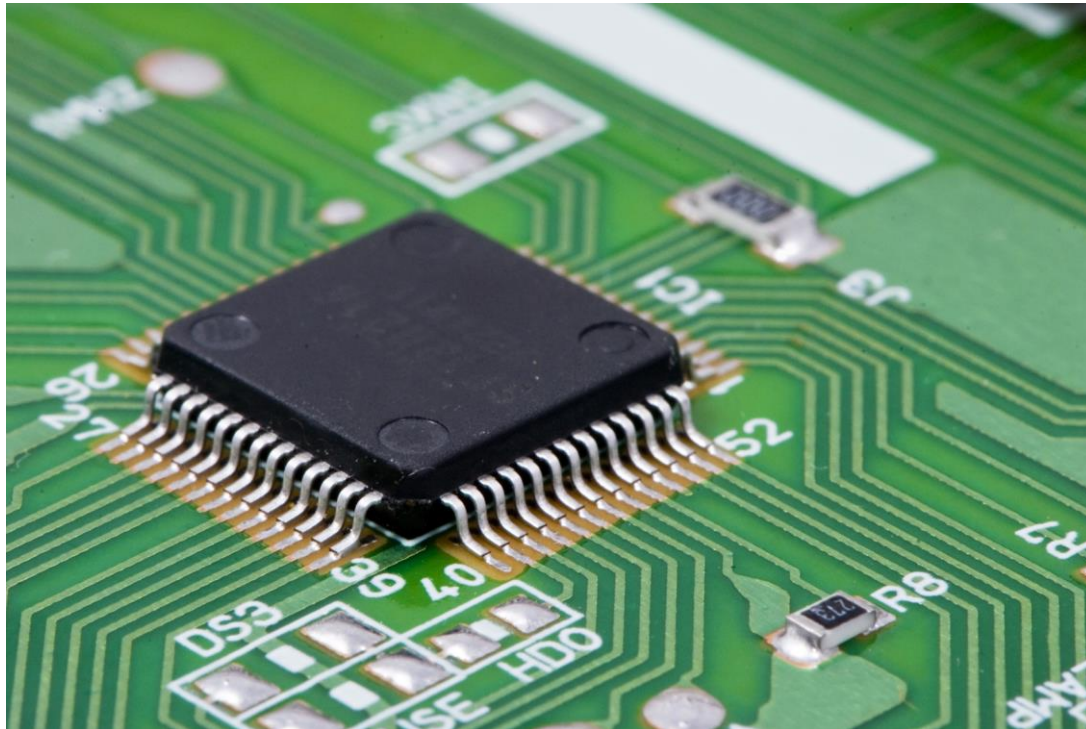
- Phosphorus analysis in electroless Ni
- Improved detection limits down to Angstrom or ppm level
- Separation of overlapping elements
- Improved stability with minimal drift
- Less maintenance

# X射线管靶材



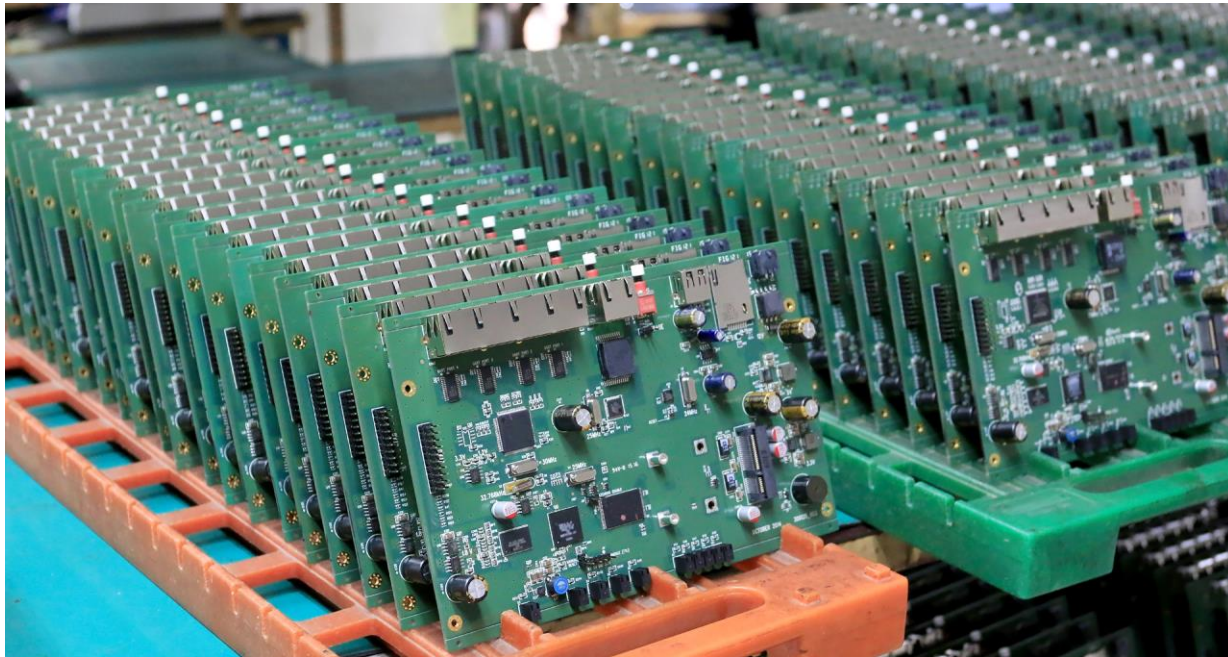
# *Optimized for challenging applications*

- Cr
  - Thin Electroless Nickel (less than 10 uin mid Phos)



# *Optimized for challenging applications*

- Mo
  - ENIG/ENEPIG
  - Immersion Ag



# *Optimized for challenging applications*

- W
  - Zn, ZnNi; Transition metal plating



# *Optimized for challenging applications*

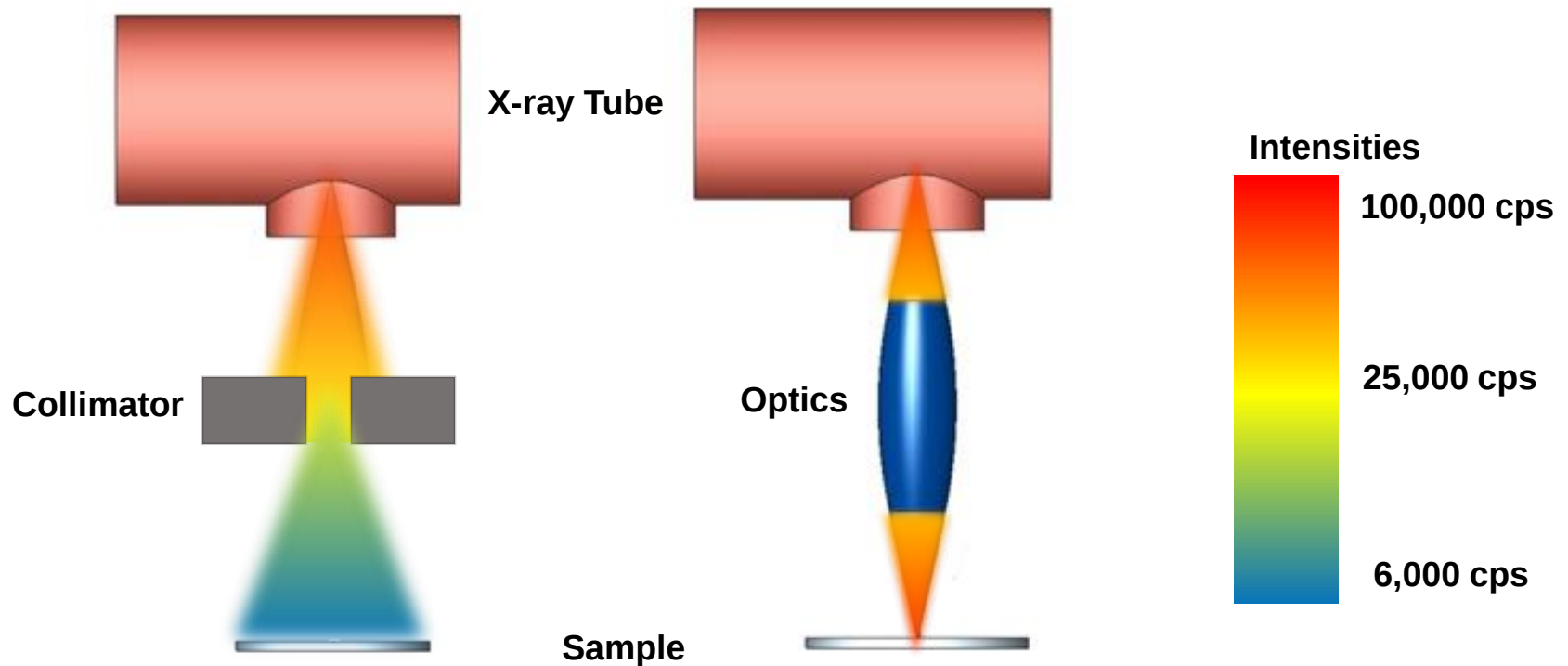
- Rh
  - Painting pretreatment



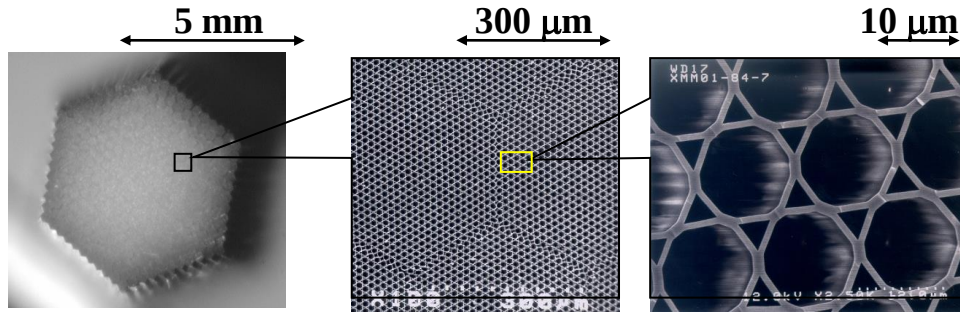
# X射线光路

# Reduce the inverse square loss

- Inverse square rule is a specified physical quantity where intensity is inversely proportional to the square of the distance from the source of that physical quantity.
- For analysis of feature as small as 15um



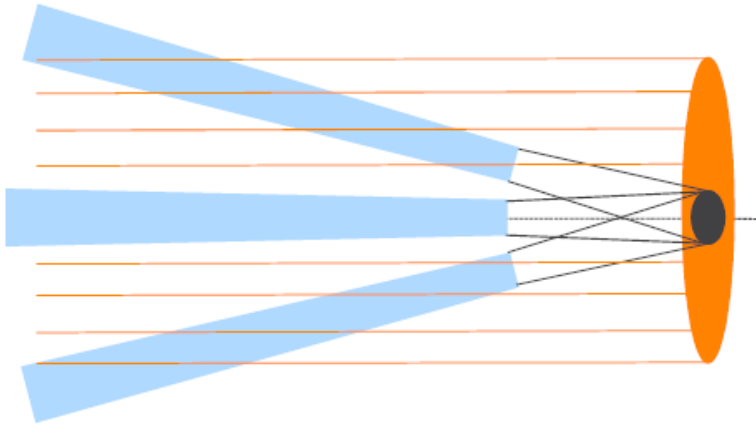
# *Poly-capillary focusing optics*



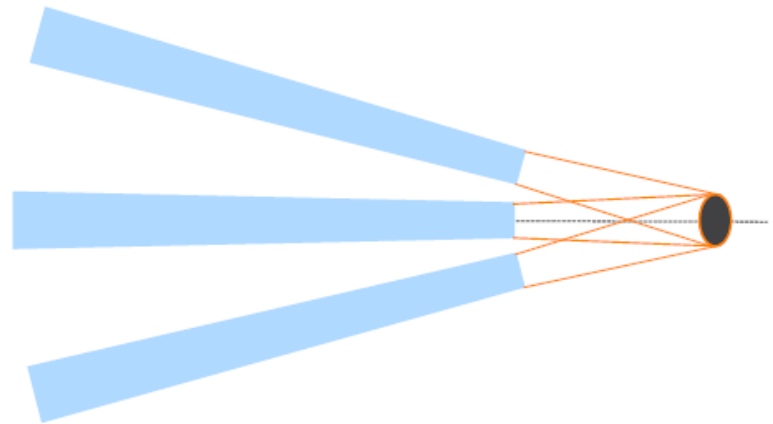
# 光晕效应

- Halo effect is due to high energy  $>20\text{keV}$  X-ray penetrating through the capillaries

**Standard Optic**



**Halo Reduction Optic**



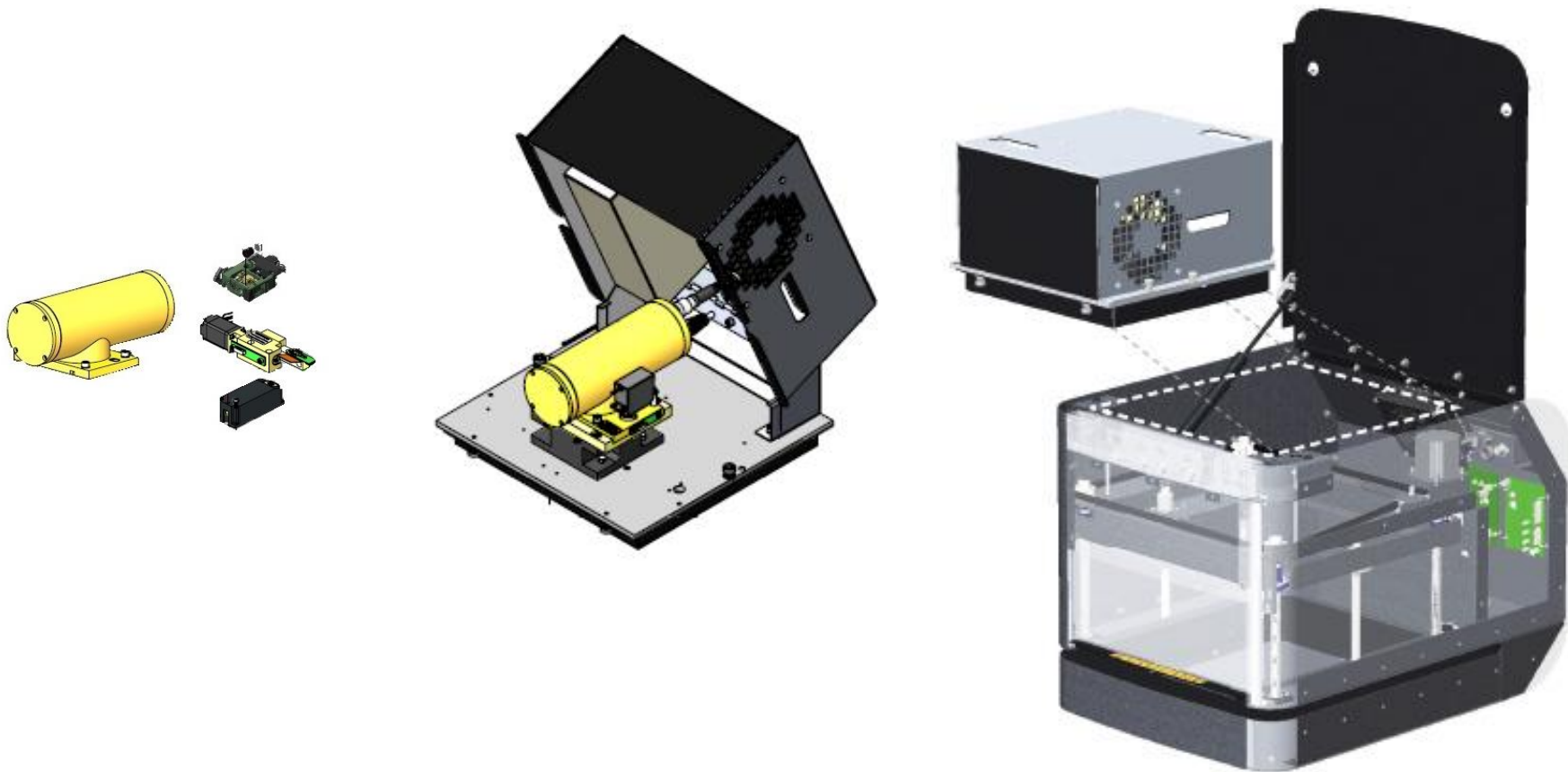
# 模块化设计

# 模块化设计

- All major components reside in “head”
- Head can be easily removed
- Minimize downtime
- Components can be upgraded at later date



# 模块化设计

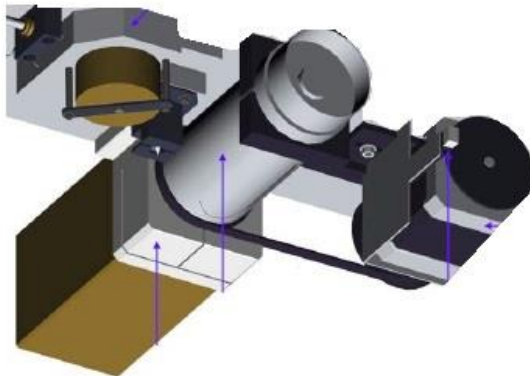


# 更小的组件

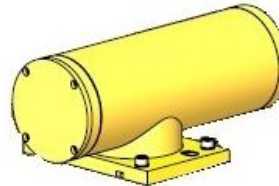
Old Camera Assembly



Old Detector & Collimator



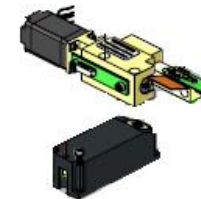
50W X-ray Tube



New Camera Assembly



New Detector & Collimator



# *Unique “smart modularity” provides significant advantages*

- Upgradability
- Serviceability
- Downtime prevention
- Lower TCO



# X荧光测厚仪的功能组件

- X-ray generation
- X-ray filtering
- X-ray collimation
- X-ray detection
- Sample vision
- Sample movement (robots)
- Machine vision (auto-focus, pattern recognition, image stitch, 2D barcode,...)
- User interface
- Software
- Report generator
- Fault protection
- X-ray safety

# X荧光测厚仪的特点

1. 非接触，非破坏的无损检测方法
2. 可同时分析5层（4层镀层+基材）及合金层厚度。  
如：Cr/Ni/Cu/ABS；ZnNi/Fe，Zn/Fe，Ni/Fe，NiCr/Cu/ABS，  
.....
3. 测量范围广 13(Al) ~ 92(U)。  
镀层厚度从几个nm ~ 100um左右可测
3. 样品无需前处理，可直接测量。。
4. 分析快速，可在几秒内测出结果
5. 具备成份分析功能，可同时测定25种元素。

