

Smart Material and Advanced packaging in Semiconductor -----3D X-ray CT sharing and hands-on

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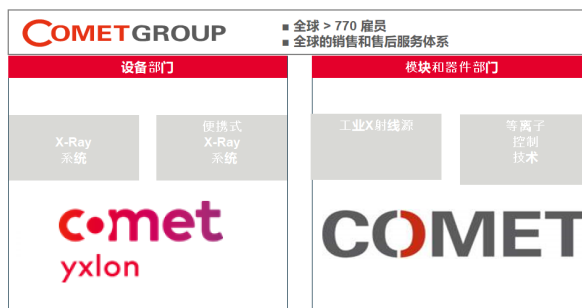
Company Confidential 3/5/2024 1

Agenda

- **Company introduce**
- Basic knowledge of X-ray
- 2D X-ray inspection and application
- CT (Computer Tomography) basic knowledge and application
- Step further in CT
- Horizontal CT and application
- Laminographic CT (PCT) and application in advance IC's package
- AI technology developing in CT

Comet Holding AG

- Stock listed company on the Zurich Stock Exchange in Switzerland
- Established 70 years ago, a lead company in developing and producing X-ray and RF components and systems
- Comet group has three business units
- PCT: Plasma Control Technologies, brand is COMET
- IXM: X-Ray Modules , brand is COMET
- IXS : X-Ray Systems, brand is Comet Yxlon



Comet Yxlon GMBH a company of the COMET Group

----- Comet Yxlon history

- 1895: Wilhelm Conrad Röntgen discovered radiation
- 1896: Carl Heinrich Florenz Müller developed the first ray tube
- 1927: Philips acquired the company established by C.H.F Röntgenmülle
- 1973: Philips developed the first metal ceramic X-ray tube
- 1998: Yxlon International X-Ray GmbH Established
- 2007: **YXLON** becomes a member of COMET Group
- 2008: **FEINFOUCS** product line merged into YXLON
- 2022: **YXLON** becomes **Comet Yxlon**
- Today: Comet Yxlon is one of the leader company in the X-ray inspection system and CT system

Comet Yxlon GMBH a company of the COMET Group

-----FEINFOUCS history

- 1982: Established by Alf Reinhold
- 1982: Developed the first micro-focus open tube in the world
- 2004: Acquired by COMET
- 2007: FEINFOUCS product line merged into YXLON



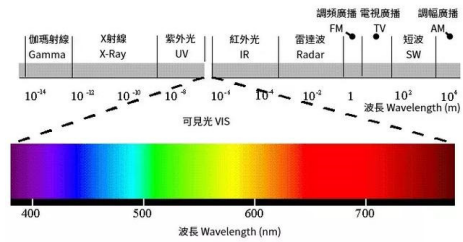
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- Company introduce
- **Basic knowledge of X-ray**
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Basic knowledge of X-ray

What is X-ray

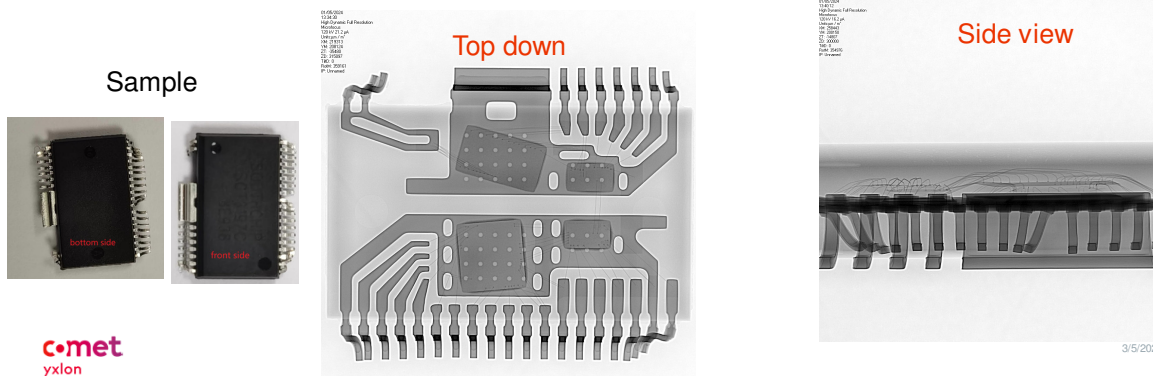
- X-rays are a kind of light
- X-rays are energy in the form of electronic waves
- X-rays is of wave-particle duality
- The difference between X-rays and visible light is that each photon contains different amounts of energy
- The energy of X-ray photons is 5000 times of ordinary light photons.
- X-ray characteristics:
 - Due to the high energy of its photons, they can penetrate objects
 - During the penetration, parts of X-ray is absorbed by objects ; parts of X-ray go thought the objects



Basic knowledge of X-ray

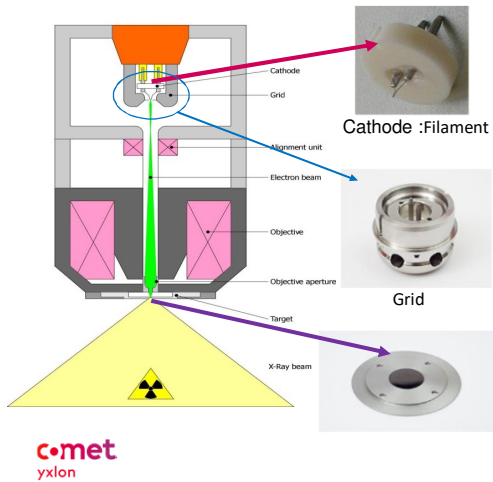
What can be done by X-ray in Failure Analysis

- To make invisible to be visible ---Detection of hidden and interior defects without effort or destruction
- Non-destructive inspection method ---- No need to disassemble, prepare or clamp components
- Increase yield and reduction of inspection costs
- Reduction of product development time and accelerated ramp-up time



Basic knowledge of X-ray

How to generate X-ray



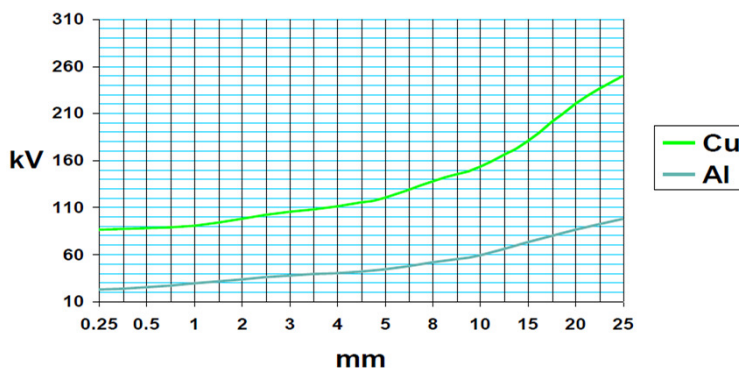
- Current is applied to the *Cathode* (filament) causing it to heat up and produce a cloud of electrons
- The energy generated by the electron beam is a result of excitation of atoms which free their electrons from orbit.
- These electrons are now free to become part of the electron beam.
- This beam is then accelerated through a high voltage field, gaining speed and energy until the electrons strike the target, where this energy is converted into heat and X-ray.
- Energy that is converted to heat is radiated through the anode, the remaining energy is given off as an X-ray.
- This energy is approximately 0.1 - 2% of the total amount of energy produced by the electron beam.
- This X-ray is energy in the form of an electromagnetic wave.

Key point: when switching off the system, then X-ray will be stopped at once

Key parameter of X-ray system

KV:

- KV : used to measure the electronic beam power;
- the higher the KV, the higher the penetration capability
 - The higher the density material, need higher KV
 - The thicker the material, the higher the KV to penetrate

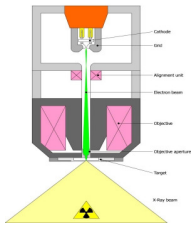


Key parameter of X-ray system

Power: To decide the X-ray intensity which is generated by X-ray tube

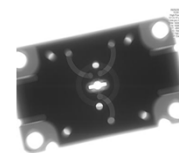
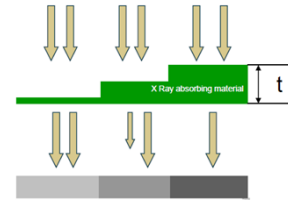
Relating definition:

- Tube current : the sum of electron generated by the filament
- Target current: the sum of electron which hit the target
- Tube Power = KV x Tube current
- Target Power = KV x target current



Feature:

- The higher Target power, the higher X-ray output power
- The higher X-ray intensity, the better object grey value contrast which generated by detector



Target Power=5.6W

Target Power=3W

Key parameter of X-ray system

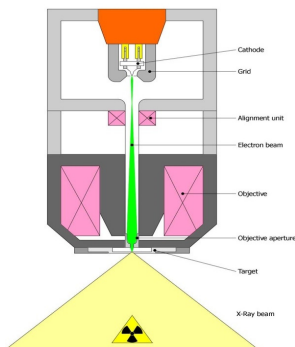
Focus spot size:

Easy to understand Focal spot size:

- The diameter of the max area which electron hit the target

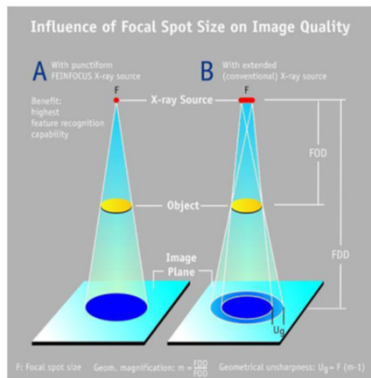
Feature:

- Focal spot size is one of main parameter to measure X-ray tube performance
- The smaller focal spot size, the smaller defect can be detected
- The focal spot size will be larger with target power increased

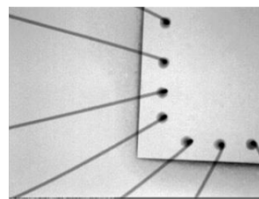


Key parameter of X-ray system

Geometric Unsharpness :



- The smaller Focal Spot Size, the sharper the X-ray image
- The larger of focal spot size, the larger of geometric unsharpness



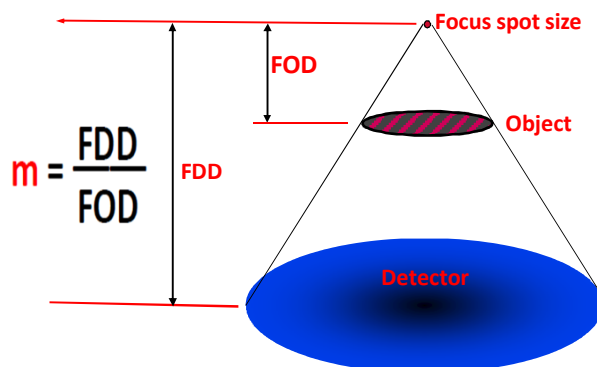
Focus spot size : 2µm



Focus spot size : 5µm

Key parameter of X-ray system

Geometric magnification definition :



Agenda

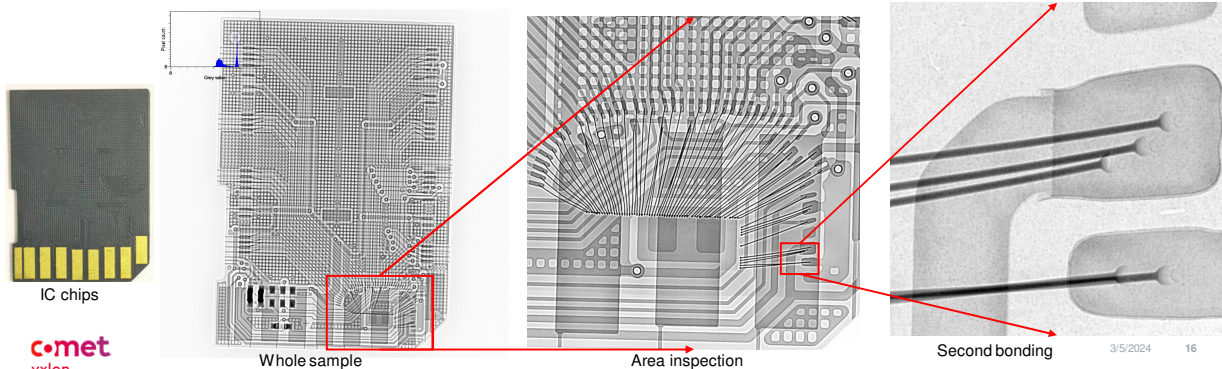
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What's the key point during 2D X-ray inspection

One of the key point in 2D X-ray inspection

----- Geometric magnification as higher as possible

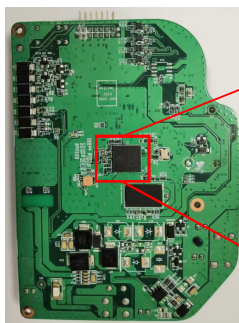
- The aim of a microfocus X-ray inspection system is to enlarge part of the object and inspect the micro defective
- The higher the Geometric magnification, the stronger the capability to see sub-micro defects



What's the key point during 2D X-ray inspection

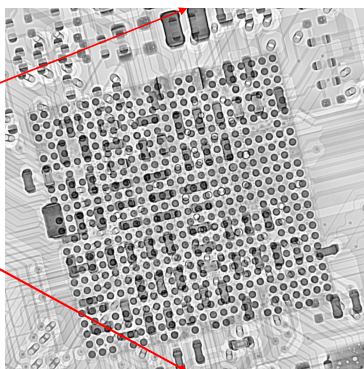
Another key point: Rotate sample and find specified angel to separate the target object from surround, reason:

- X-rays are light , light travels in straight lines
- The X-ray image is overlap and reflects multi-layers information

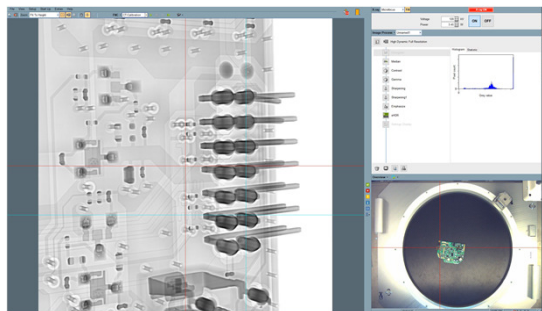


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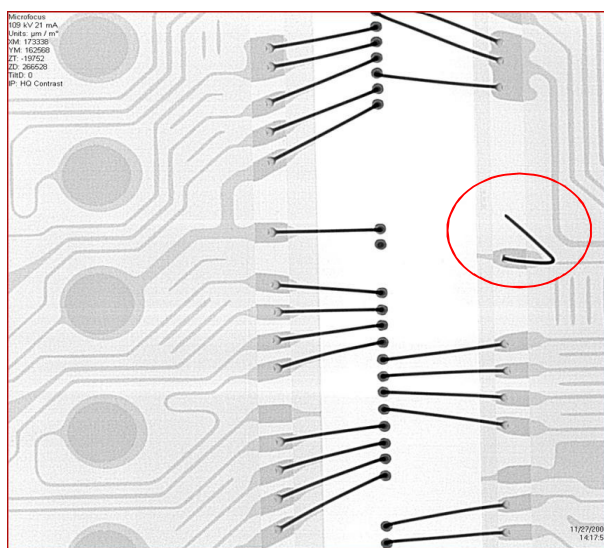
Overlap X-ray image



find specified angel to separate the target object from surround, reason:

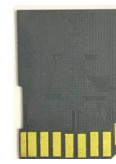
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Typical 2D inspection in Semiconductor---standard package



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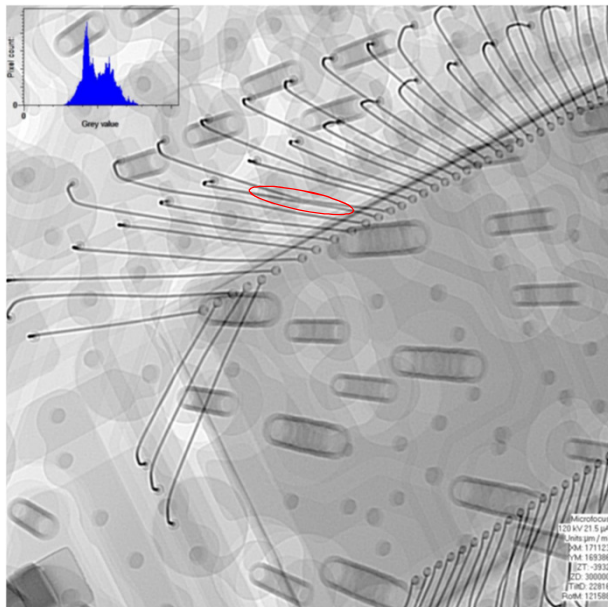
Wire broke inside IC chips



IC chips

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Typical 2D inspection in Semiconductor--standard package



Wire short inside IC chips

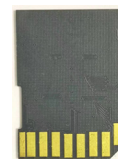


IC chips

Typical 2D inspection in Semiconductor--standard package

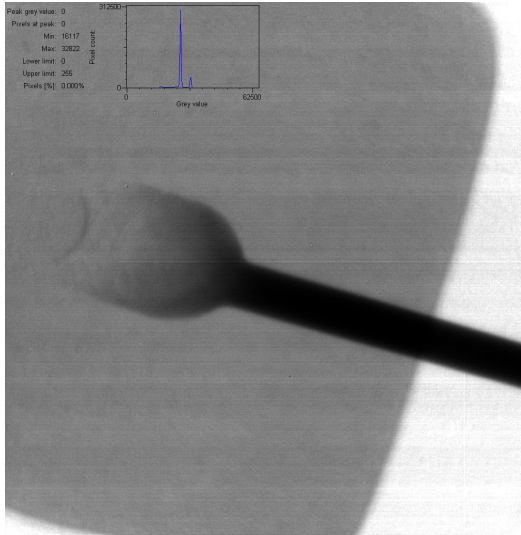


Wire sweep measurement inside IC chips

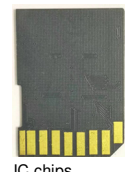


IC chips

Typical 2D inspection in Semiconductor---standard package



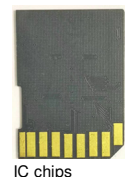
Second bonding inspection inside IC chips
(Fish Tail)



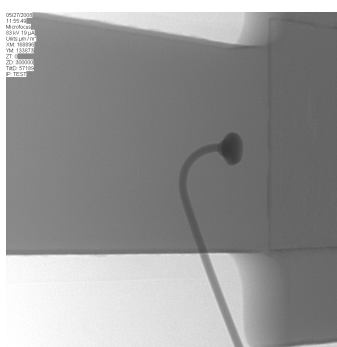
Typical 2D inspection in Semiconductor---standard package



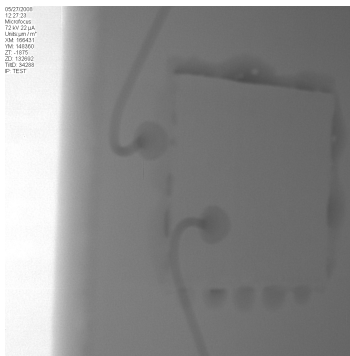
Second bond left from die-attached



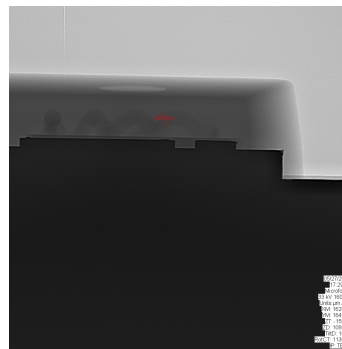
Typical 2D inspection in Semiconductor--standard package



Gold wire



Cu wire



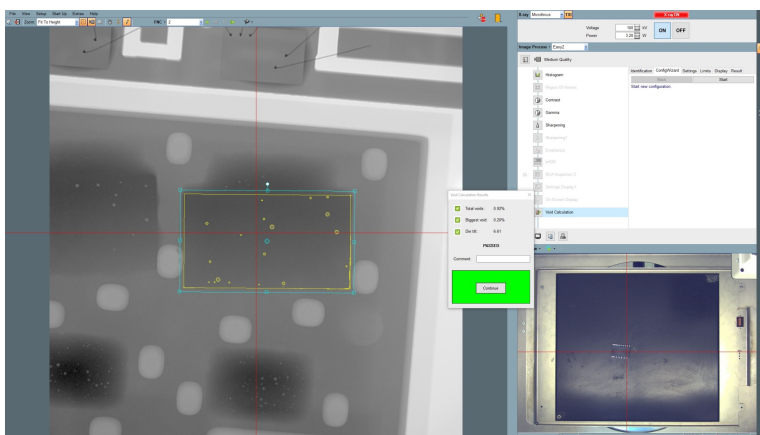
aluminium wire



IC chips

Typical 2D inspection in Semiconductor--standard package

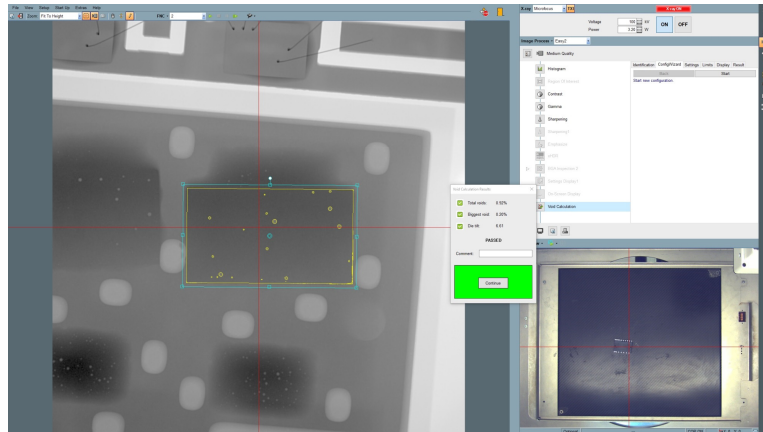
Void percentage calculation for power IC



IC chips

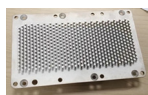
Typical 2D inspection in Semiconductor---standard package

Void percentage calculation for power IC

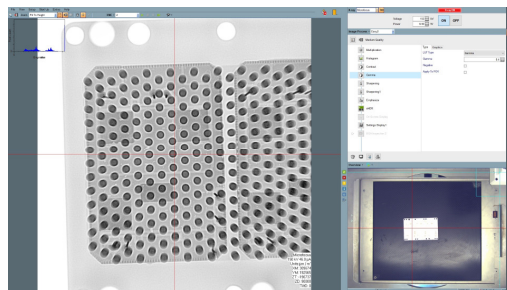


Typical 2D inspection in Semiconductor---standard package

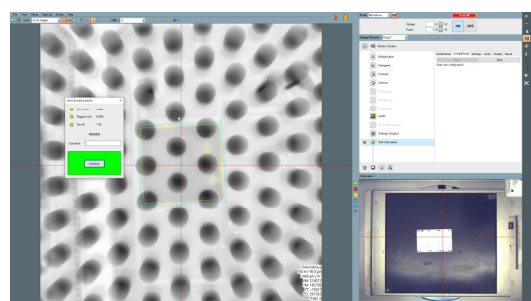
IGBT inspection ----- main focus on void percentage calculation



IGBT



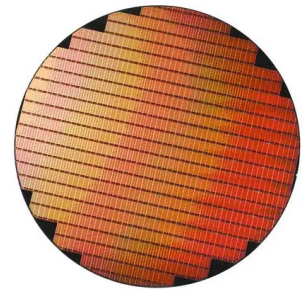
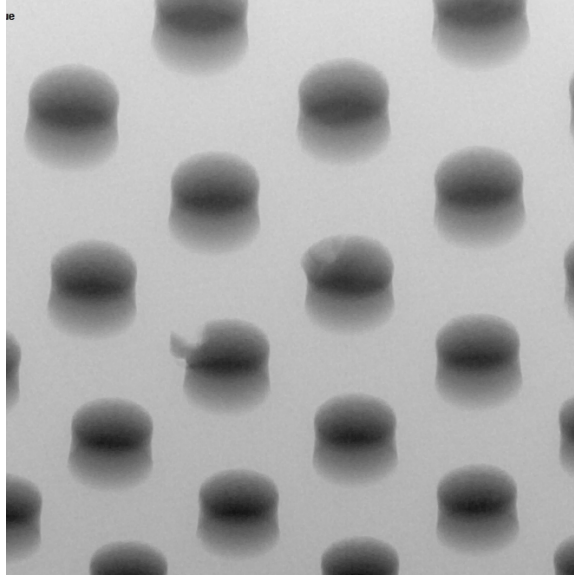
2D image



Void calculation

Typical 2D inspection in Semiconductor---wafer level

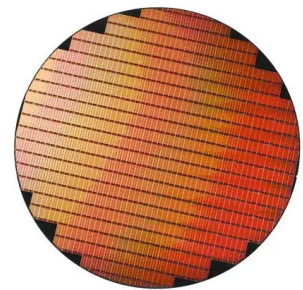
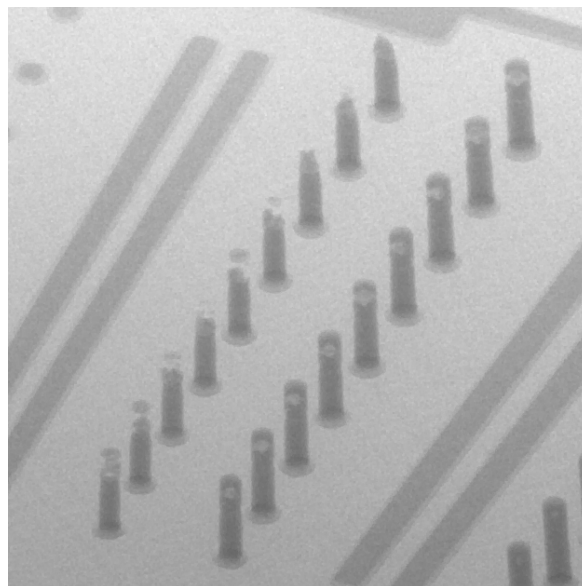
Cu Pillar inspection
(30µm diameter)



Wafer

Typical 2D inspection in Semiconductor---wafer level

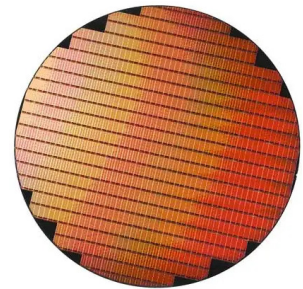
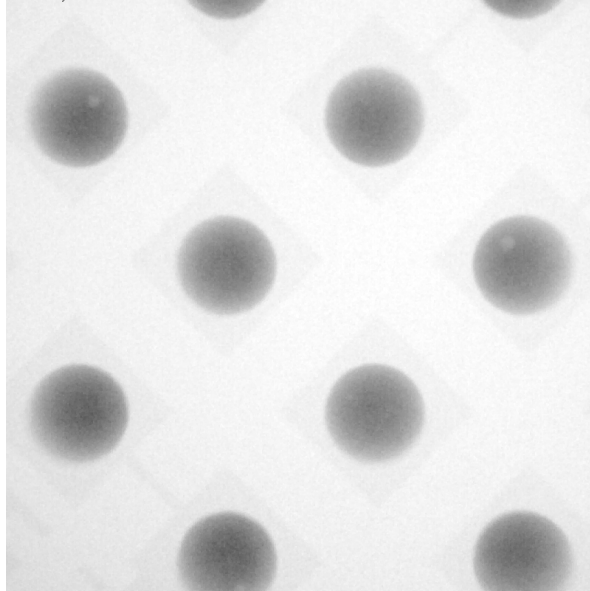
TSV inspection
(10µm diameter)



Wafer

Typical 2D inspection in Semiconductor---wafer level

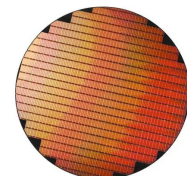
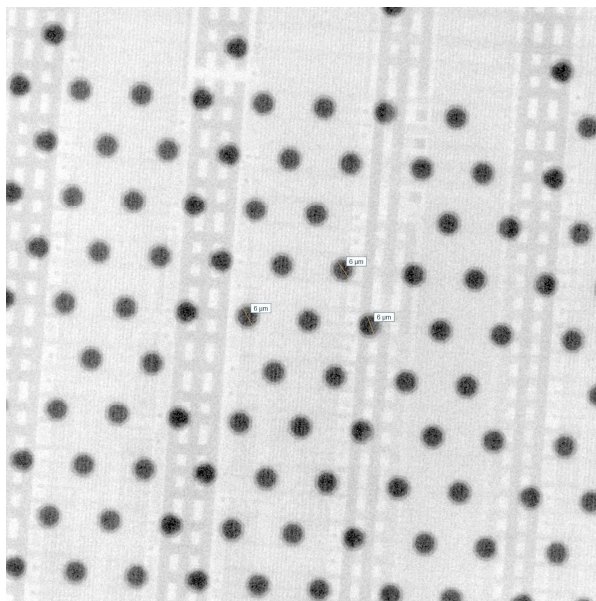
bumping inspection
(30 μ m diameter)



Wafer

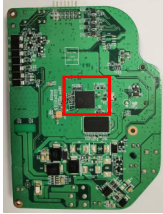
Typical 2D inspection in Semiconductor---wafer level

bumping inspection
(10 μ m diameter)

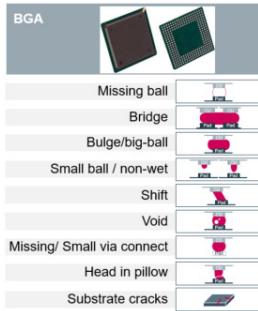
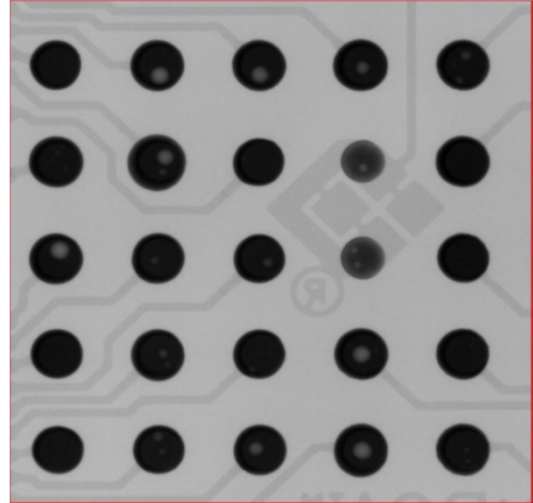


Wafer

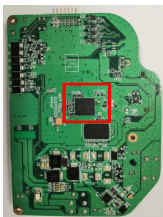
Typical 2D inspection in SMT



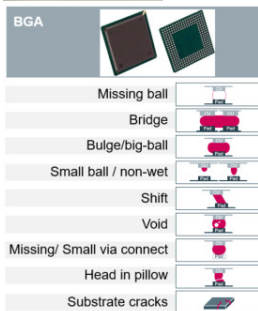
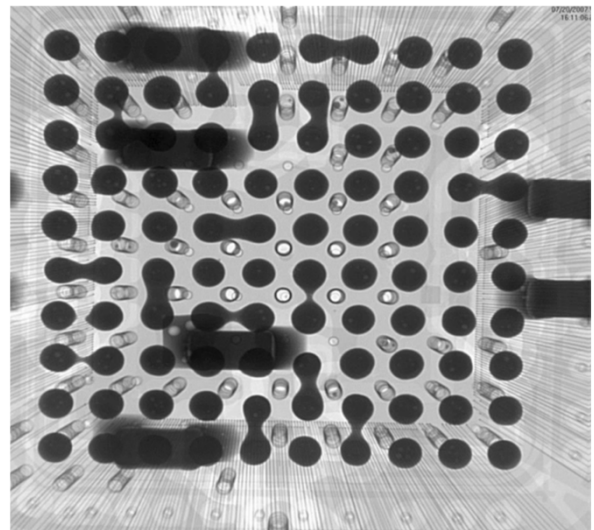
BGA soldering defective
----- missing ball



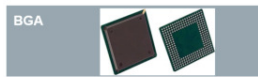
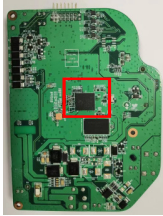
Typical 2D inspection in SMT



BGA soldering defective
----- Bridge



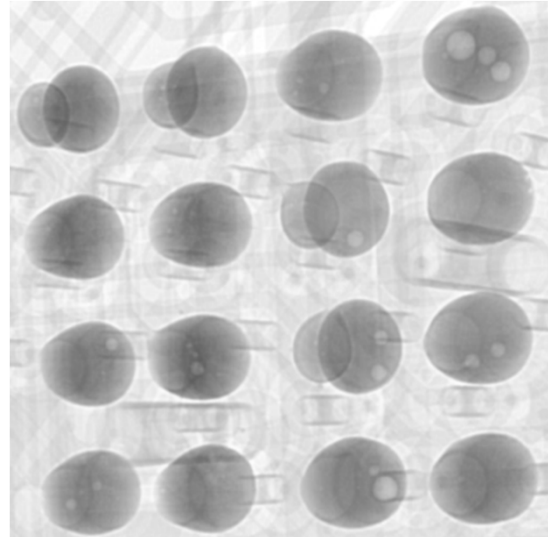
Typical 2D inspection in SMT



Missing ball	
Bridge	
Bulge/big-ball	
Small ball / non-wet	
Shift	
Void	
Missing/ Small via connect	
Head in pillow	
Substrate cracks	

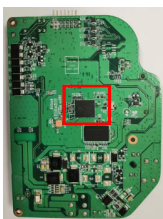
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BGA soldering defective
----- open



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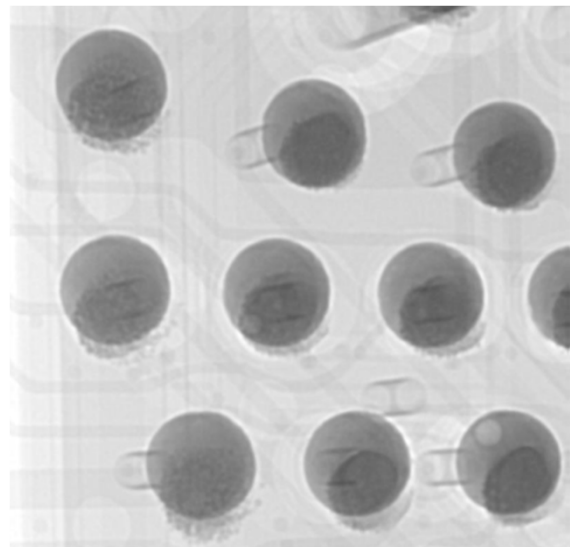
Typical 2D inspection in SMT



Missing ball	
Bridge	
Bulge/big-ball	
Small ball / non-wet	
Shift	
Void	
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Head in pillow	
Substrate cracks	

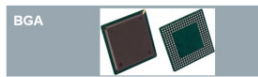
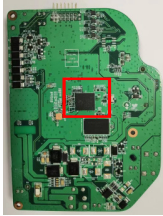
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yxlon










BGA soldering defective
----- cold joint



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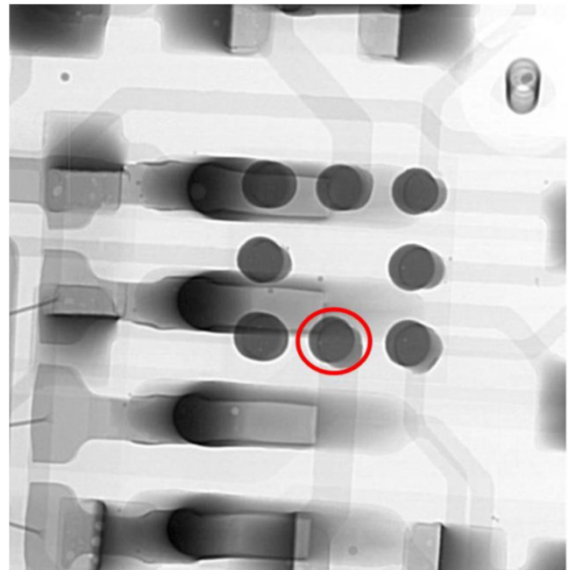
Typical 2D inspection in SMT



- Missing ball 
- Bridge 
- Bulge/big-ball 
- Small ball / non-wet 
- Shift 
- Void 
- Missing/ Small via connect 
- Head in pillow 
- Substrate cracks 

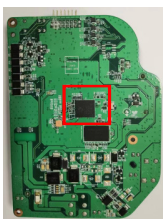
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BGA soldering defective
----- shift



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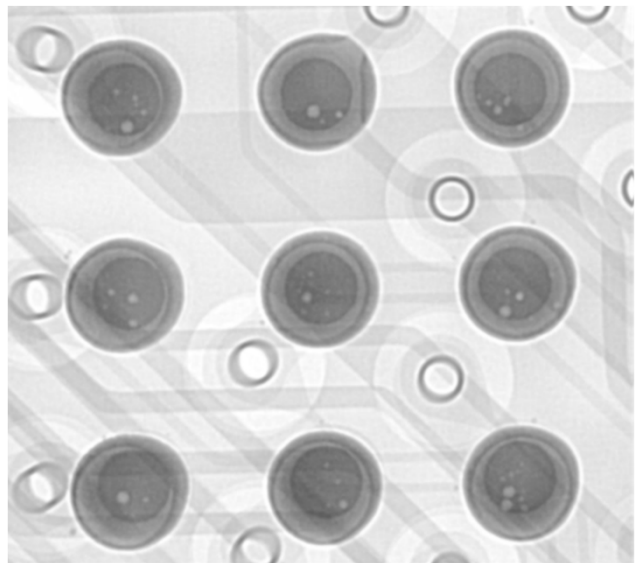
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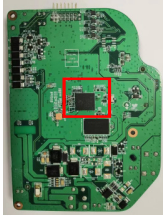
comet
yxlon

BGA soldering defective
----- void

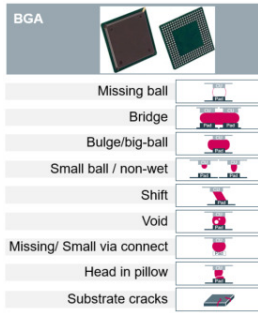
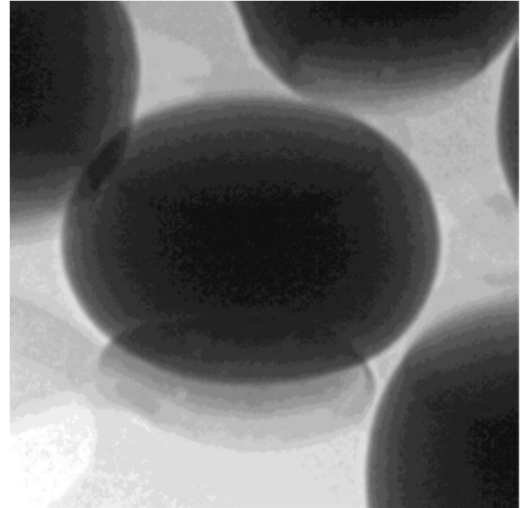


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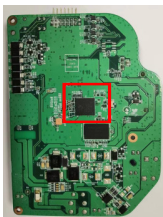
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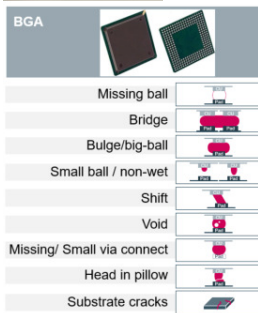
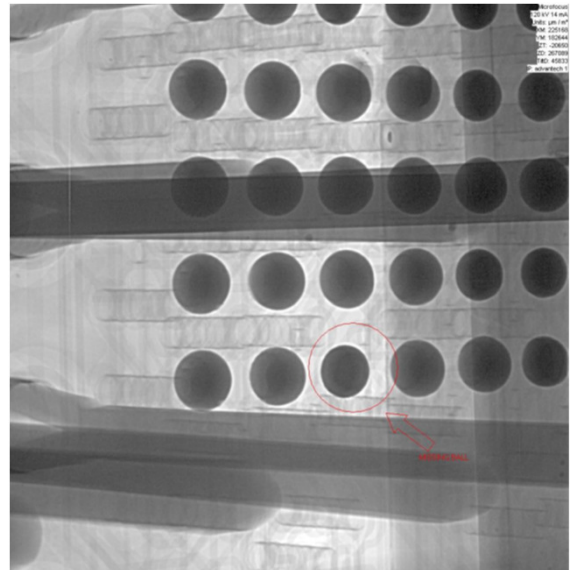
BGA soldering defective
----- Head in Pillow



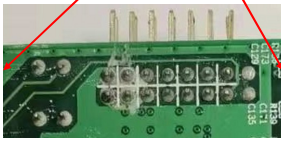
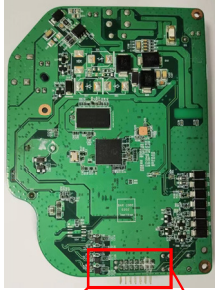
Typical 2D inspection in SMT



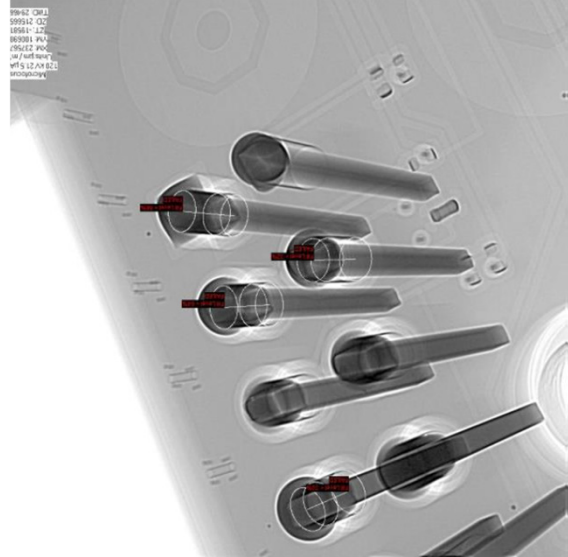
BGA soldering defective
----- small ball



Typical 2D inspection in SMT



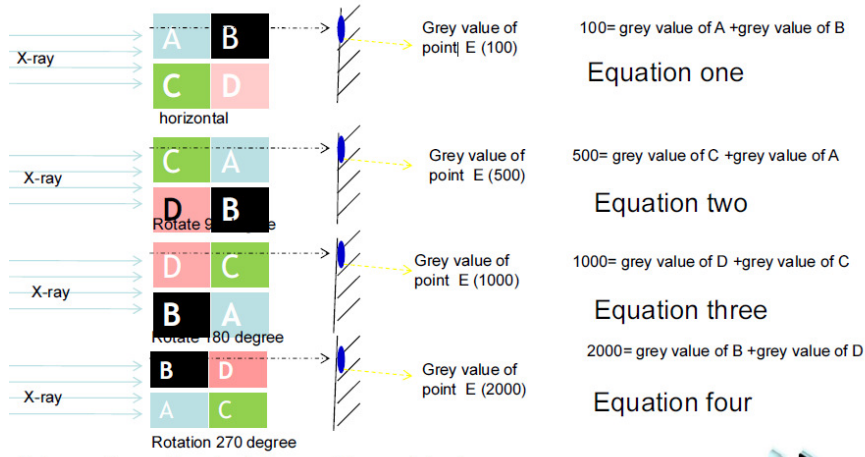
Through hole soldering
defective
----- THT measurement



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- **CT (Computer Tomography) basic knowledge and application**
- Step further in CT
- Horizontal CT and application
- Laminographic CT (PCT) and application in advance IC's package
- AI technology developing in CT

CT (Computer Tomography) basic theory (1)

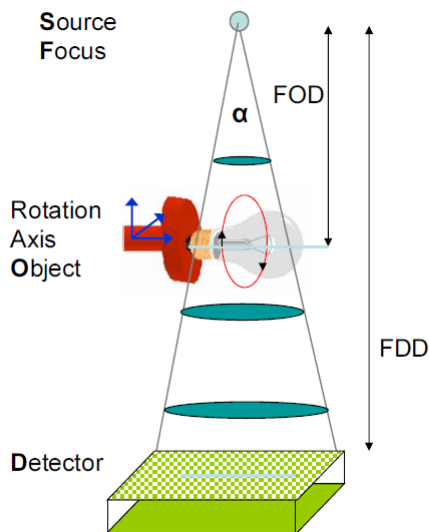


Using mathematic calculation, get four point value,
Grey value of A= ? Grey value of B=?
Grey value of C=? Grey value of D=?

3D result

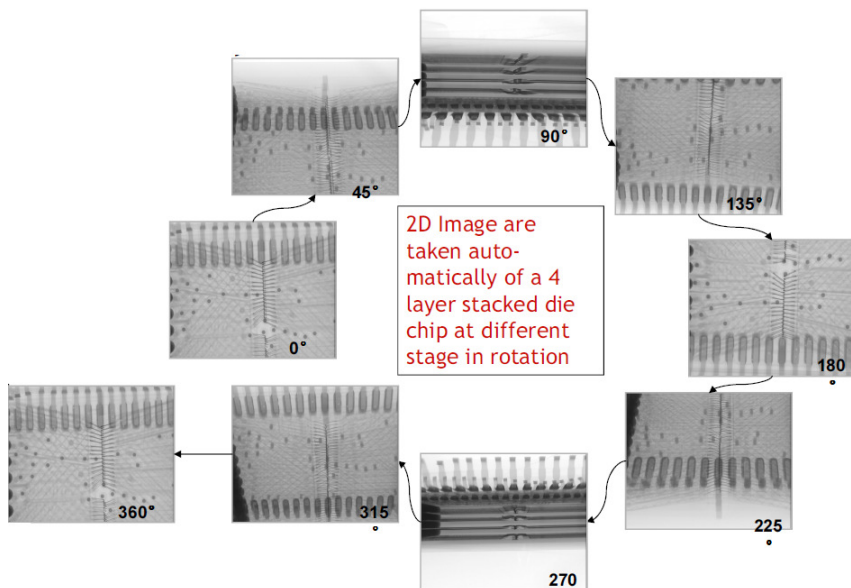


CT (Computer Tomography) basic theory (2)



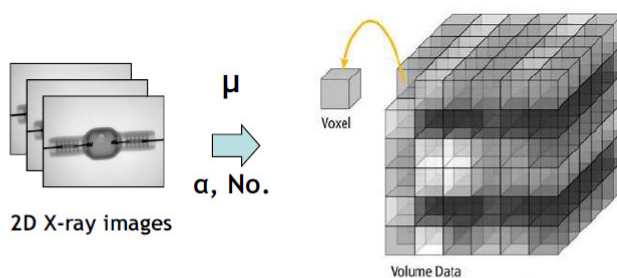
Sample rotate 360 degree around the horizontal axis

CT (Computer Tomography) basic theory (3)

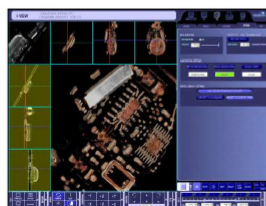


CT (Computer Tomography) basic theory (4)

After acquisition of a selected # of 2D Images they are reconstructed into 3D data following the Feldkamp arithmetic's



3D reconstructed Data set is then processed in the 3D analysis software workstation



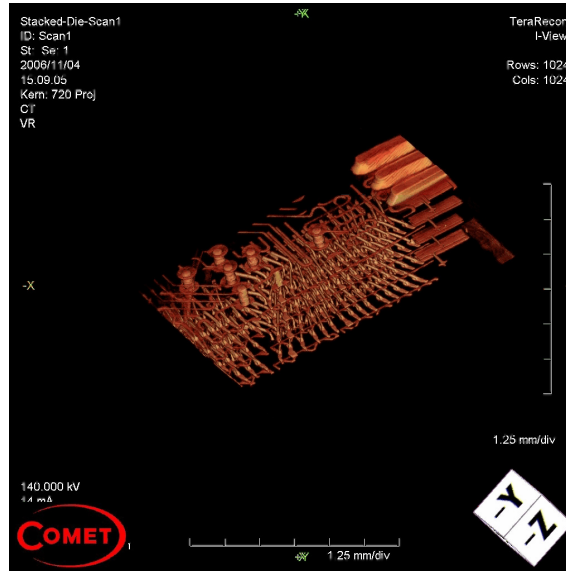
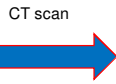
118.000 kV
9 mA
Tilt: 0.000
FOV: 0.000 mm
Thickness: 0.090 mm

CT (Computer Tomography) basic theory (5)

CT movies demo



X-ray 2D image



CT (Computer Tomography) basic theory (6)

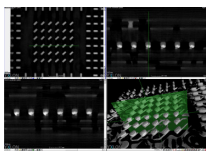
Simple summary

- CT data is obtained via mathematical calculations from 2D X-ray image
- Defective in 2D can not be seen, then it can not be seen in CT
- The better 2D image grey value contrast, the better CT grey value contrast
- CT data is grey value. 3D color CT is artificially coloured
- The more 2D projects or integration, the better CT data (higher Signal to Noise Ratio)

CT (Computer Tomography) basic theory (7)

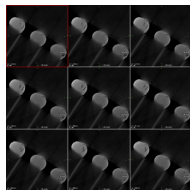
The application of CT

- Using 3D analysis software to achieve electronic cross-section and grinding of objects
- Via 3D analysis software, to analysis object, including
 - View object in different angel (rotation)
 - Finish electronic cross-section and display object information by slice
 - three-dimensional measurement which can not be finished by three-dimensional measuring equipment from outside
 -

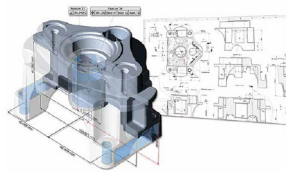


Analysis Cu pillar connecting in advance IC package

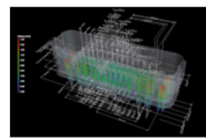
comet
yxlon



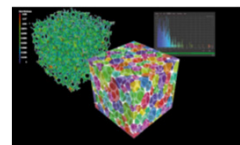
Deeply analysis BGA crack distribution in space (BGA soldering F/A)



coordinate measurement



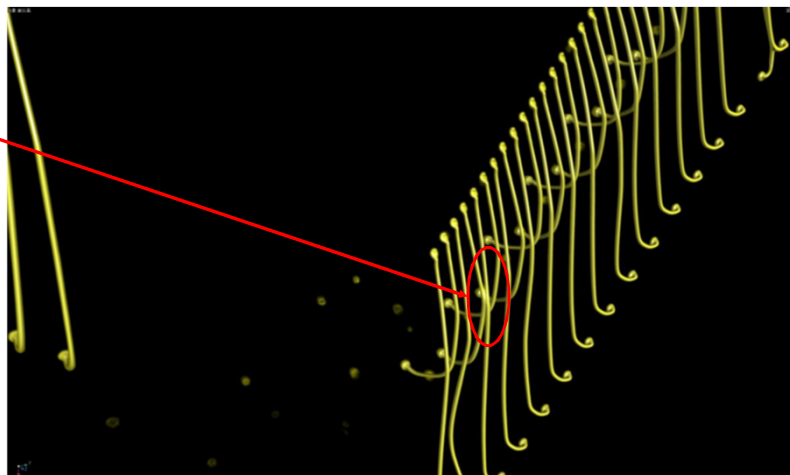
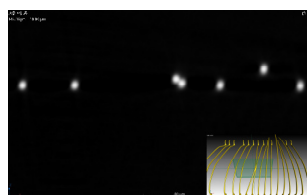
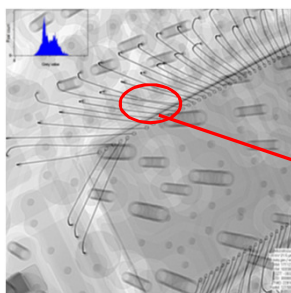
actual/nominal comparison f



porosity/inclusion analysis

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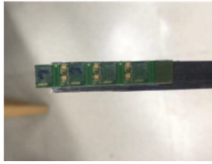
Typical application of CT ---- for IC package



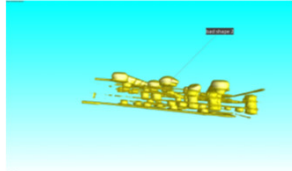
comet
yxlon

3/5/2024 48

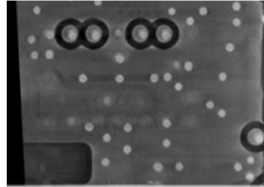
Typical application of CT --- for IC substrate



Sample



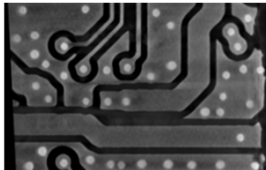
3D image



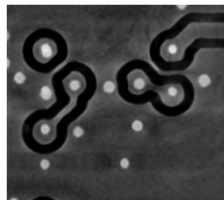
Slice for layer 1 (X-Y)



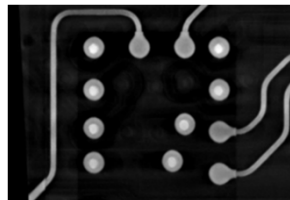
Slice for layer 2 (X-Y)



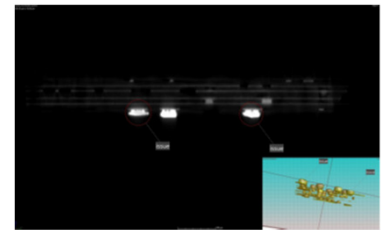
Slice for layer 3 (X-Y)



Slice for layer 4 (X-Y)

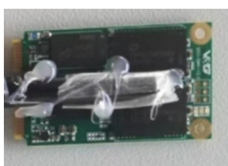


Slice for layer 5 (X-Y)

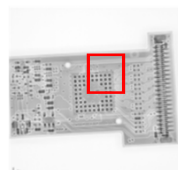


Slice for Z axis

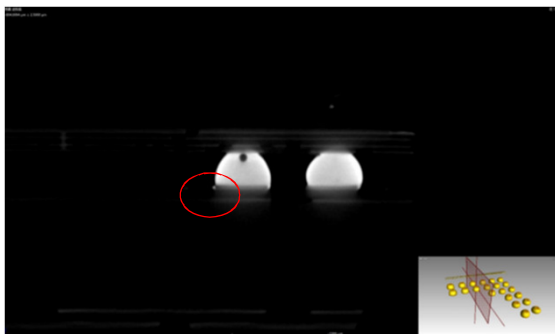
Typical application of CT --- BGA soldering in SMT industry



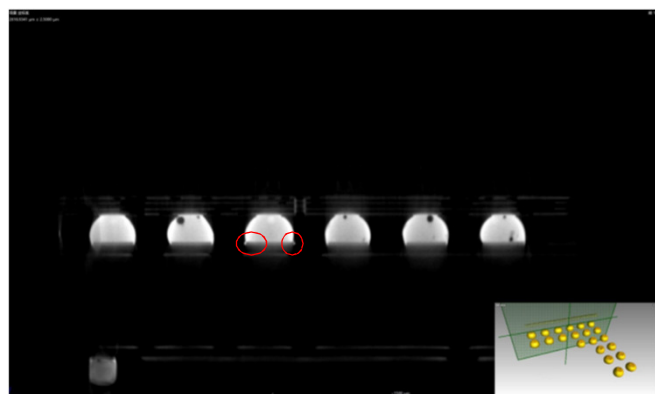
Sample



X-ray image

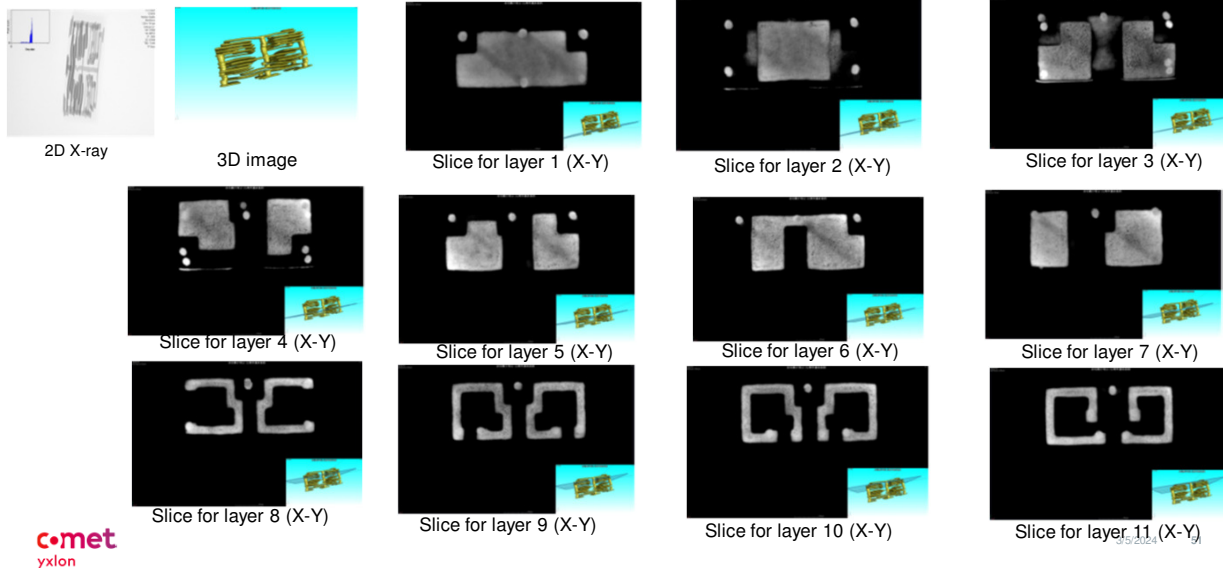


Slice 1 (Z axis)

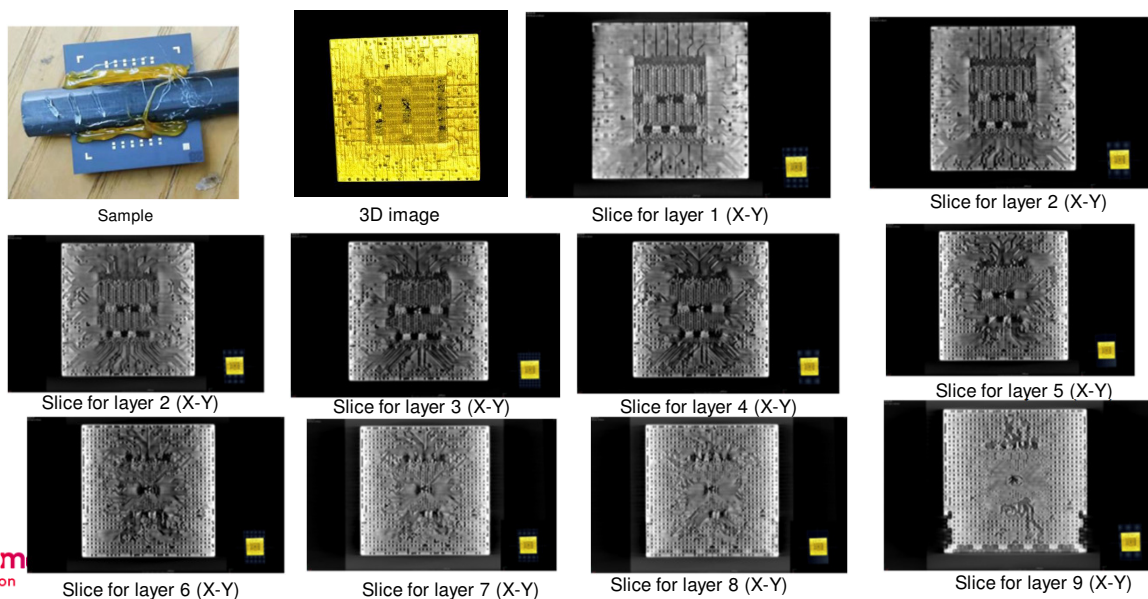


Slice 2 (Z axis)

Typical application of CT --- for Ceramic Antenna



Typical application of CT --- for Ceramic IC substrate



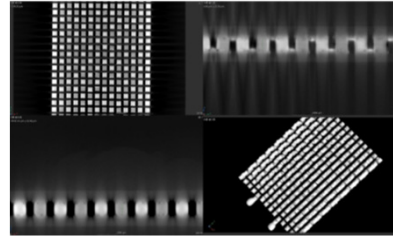
Typical application of CT --- for thermoelectric cooler



Sample



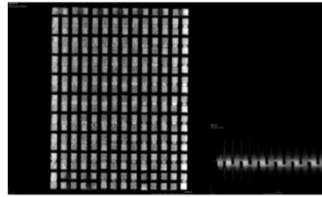
2D X-ray



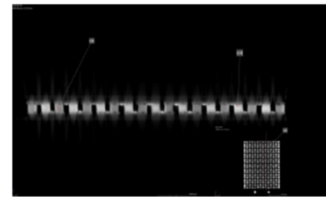
quarter image



Slice1 (X-Y cross-section)



Slice2 (X-Y cross-section)



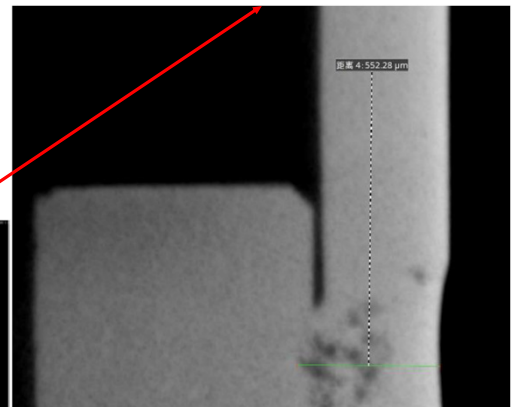
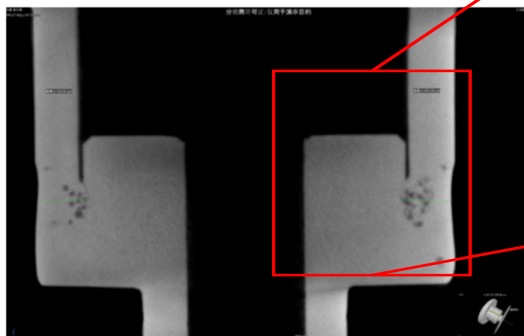
Slice3 (Z cross-section)

Typical application of CT --- Depth of fusion by laser soldering

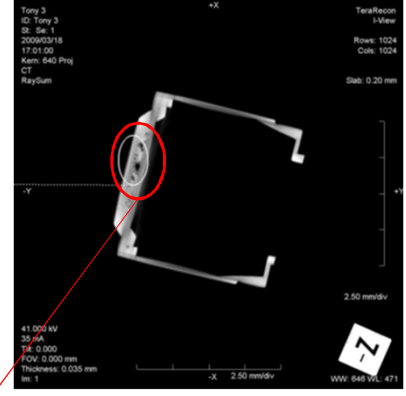
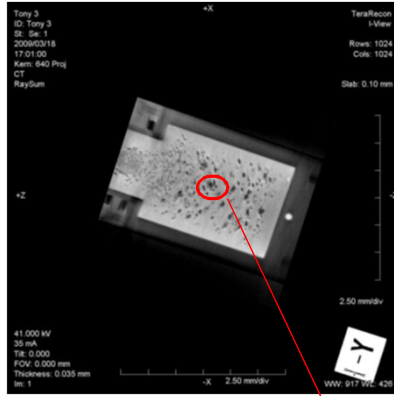
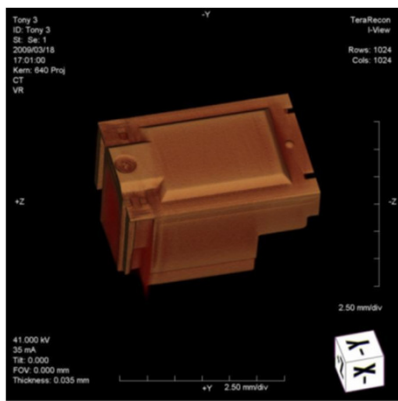


Melt point

Sample

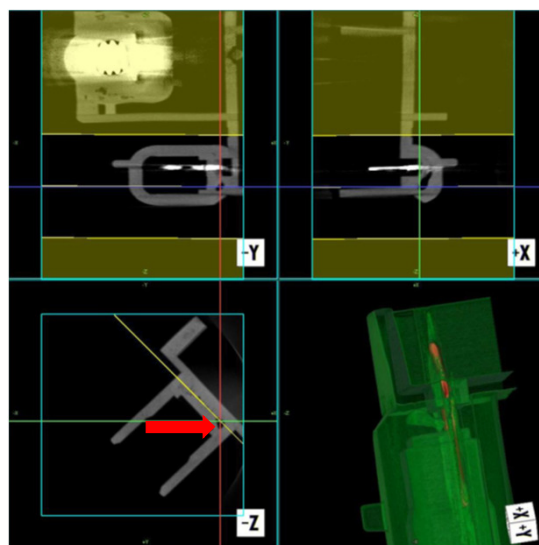
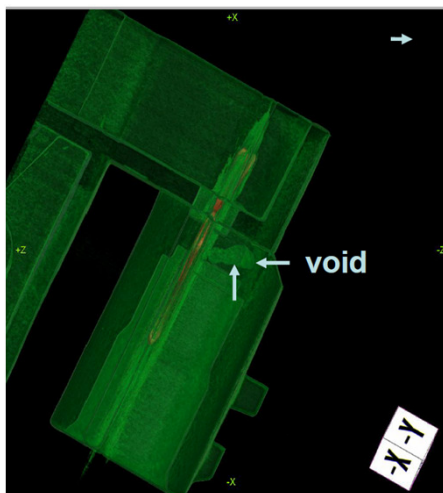


Typical application of CT --- Fiber optic connectors with high-strength carbon fibers

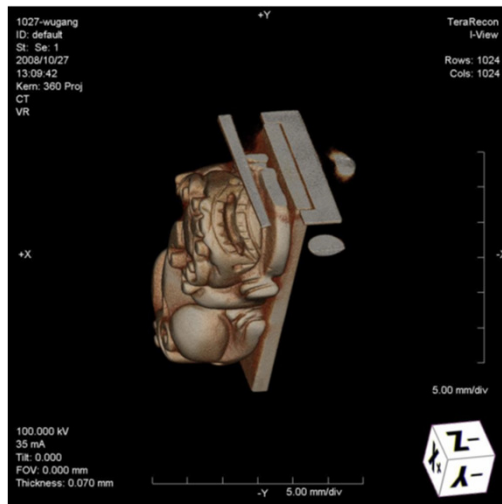
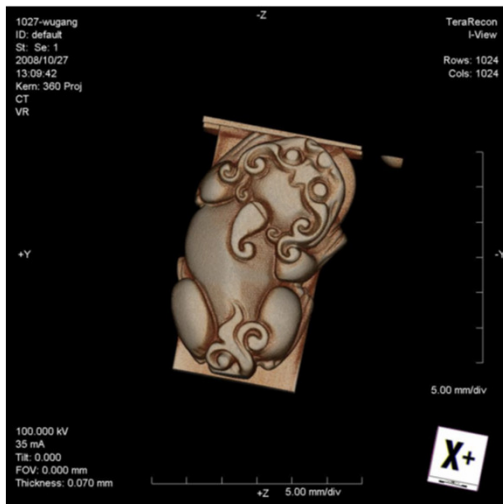


Void inside plastic

Typical application of CT --- Plug connect



Typical application of CT --- Jade pieces



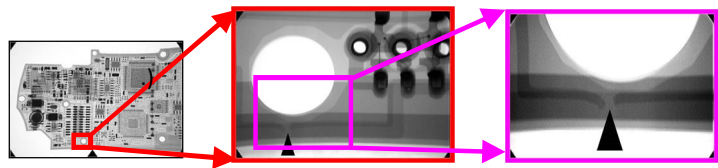
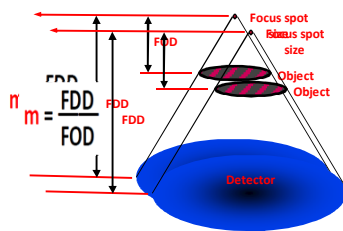
Agenda

- Company introduce
- Basic knowledge of X-ray
- 2D X-ray inspection and application
- CT (Computer Tomography) basic knowledge and application
- **Step further in CT**
- Horizontal CT and application
- Laminographic CT (PCT) and application in advance IC's package
- AI technology developing in CT

Step further in CT ----- The essence and key point of CT scan (1)

Magnification----The first essence and key point of CT during failure analysis

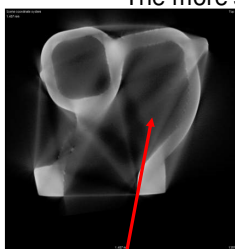
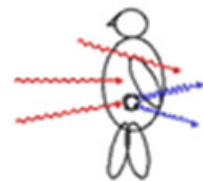
- The essence of CT for failure analysis
 - Via optical amplification of internal defects and three-dimensional dimensions of objects, Obtaining CT information of objects through a computer
- The key point of CT for failure analysis
 - How to achieve as higher magnification as possible



Step further in CT ----- The essence and key point of CT scan (2)

Noise ---The second essence and key point of CT during failure analysis

- When X-ray penetrate object, Three appearance
 - absorption
 - penetration
 - Scatter
- Scatter
 - The higher density of material, the more Scatter
 - The more scatter, the more noise in CT data



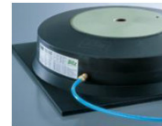
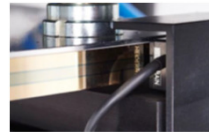
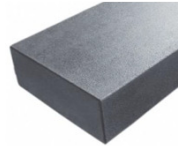
How to decrease noise in CT data		
	KV	Current
Density material Such as metal	higher KV, increase the penetration, decrease scatter	Higher current, increase the useful signal, increase the ratio of Signal to Noise Ratio
Lower density material Such as plastics	Lower KV, increase the absorption, increase material contrast	Higher current, increase the useful signal, increase the ratio of Signal to Noise Ratio

Step further in CT ----- The essence and key point of CT scan (3)

Stability of system performance ---The third essence and key point of CT during metrology

How to meet high resolution and precision requirements?

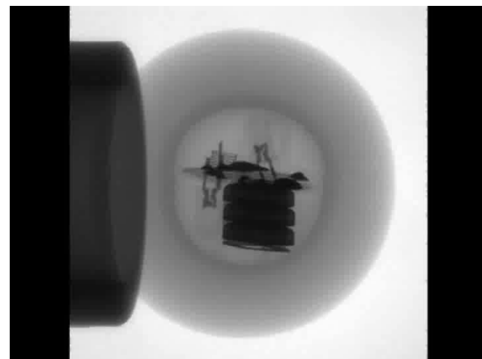
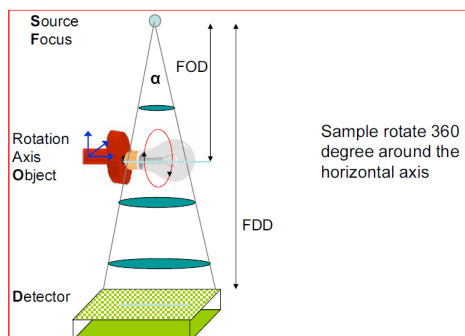
- **Granite-based manipulation**
 - for temperature stability
- **Length-and angle encoders (Heidenhain) on all axes**
 - for precise absolute position tracking: No (complicated, time-consuming) referencing necessary!
 - Compensation of temperature, motor and spindle uncertainties
- **Vibration insulators**
 - Air damping with active level control (decoupling manipulator from other components).
 - Specially designed for highly effective vibration isolation (option).



Step further in CT----- ACT & PCT

ACT (Axis CT) :

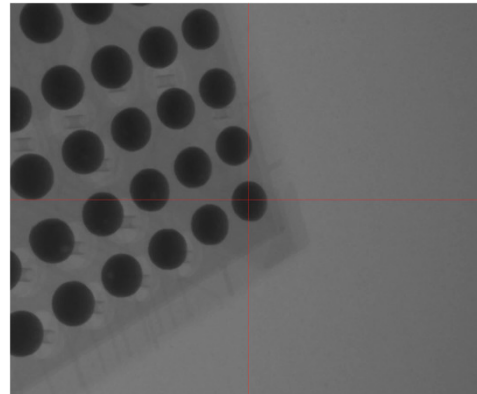
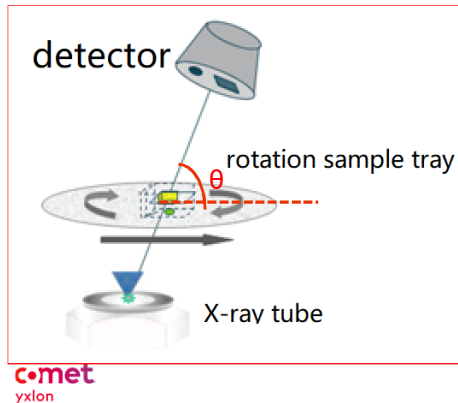
- Sample will be fixed on a fixture
- Sample will rotate 360 degree , rotation direction is perpendicular to CT rotation axis



Step further in CT----- ACT & PCT

Laminographic CT (Planer CT OR PCT) :

- Sample will be fixed on a rotation table
- The line connecting from detector and tube has certain angle with the plane of rotation table
- Rotation table will rotate 360 degree



Step further in CT----- ACT & PCT

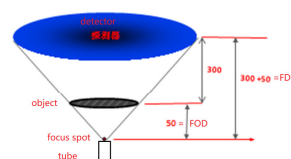
Advantage of ACT:

- full information of object has been collected Min. magnification will be need

Disadvantage of ACT:

- Sample size has been limited (ration radius $\leq 50\text{mm}$) ,The reason why:
 - Min magnification for FA must be $\cong 7$ times
 - Once system has been produced, the max FDD has been fixed
 - Calculation example according to general X-ray system in the market

$$7 = \frac{300+50}{50}$$



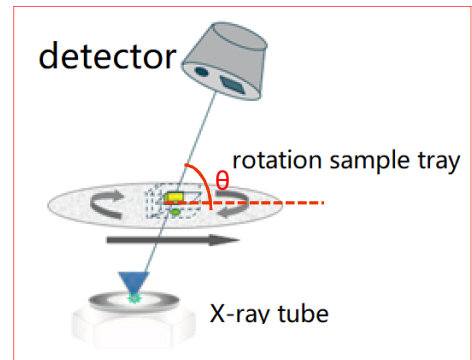
Step further in CT----- ACT & PCT

Advantage of PCT:

- The distance between tube and the rotation table can be as closer as possible
- No mag. limitation in principle

Disadvantage of PCT:

- Party of the object information is missed since there is angel between The line connecting from detector and tube to the plane of rotation table



Step further in CT----- ACT & PCT

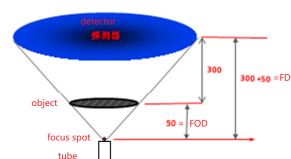
Advantage of ACT:

- full information of object has been collected Min. magnification will be need

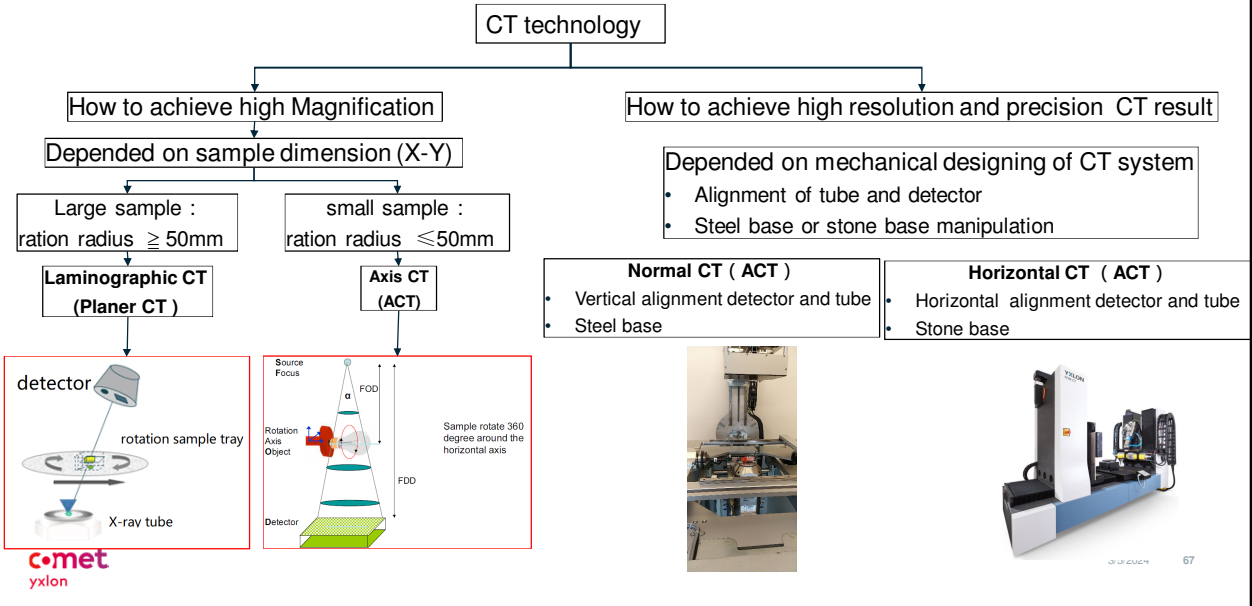
Disadvantage of ACT:

- Sample size has been limited (ration radius $\leq 50\text{mm}$) ,The reason why:
 - Min magnification for FA must be $\cong 7$ times
 - Once system has been produced, the max FDD has been fixed
 - Calculation example according to general X-ray system in the market

$$7 = \frac{300+50}{50}$$



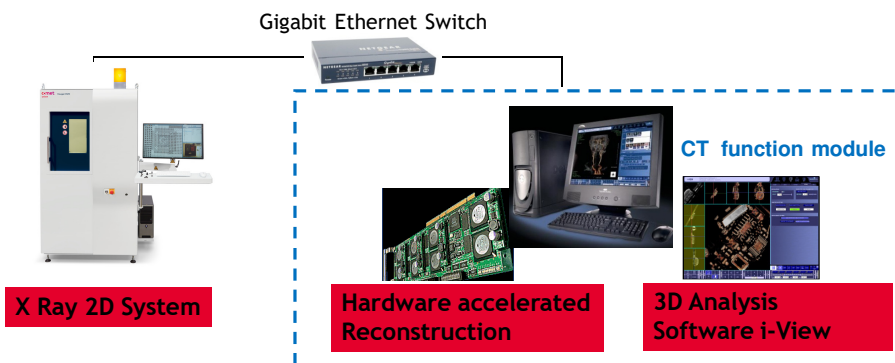
Step further in CT--- ACT & PCT



Step further in CT----- ACT & PCT

Normal CT (ACT) :

- System structure as below
- Typical application has been shown from page 46 to Page 55



Agenda

- Company introduce
- Basic knowledge of X-ray
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- CT (Computer Tomography) basic knowledge and application
- Step further in CT
- **Horizontal CT and application**
- Laminographic CT (PCT) and application in advance IC's package
- AI technology developing in CT

Horizontal CT (ACT)

Target: to get high resolution and precision CT result



FF20 CT

FF35 CT



- Granite-based manipulation for temperature stability
- Standard Vibration insulators (decoupling manipulator from other components)
- Length or angle encoders (Heidenhain) on all axes
- Highly flexible manipulators:
 - 6 (FF20 CT), 7 – 8 (FF35 CT) axis
- Various detector sizes with CsI scintillators
- New 190 kV water-cooled transmission tube – 150nm detail visibility



- Focal Spot drift correction

- Ring artifact reduction

- Noise reduction

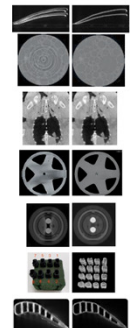
- ROI CT (Region of Interest CT)

- Beam Hardening Correction
Material specific (Bone, Steel etc.)

- MAR (Metal artifact reduction)

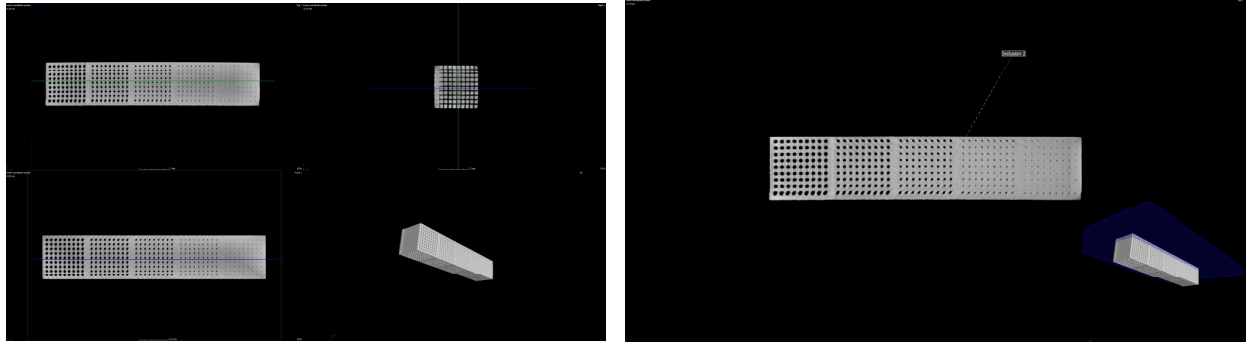
- Automated Volume Separation

- ScatterFix 2.0



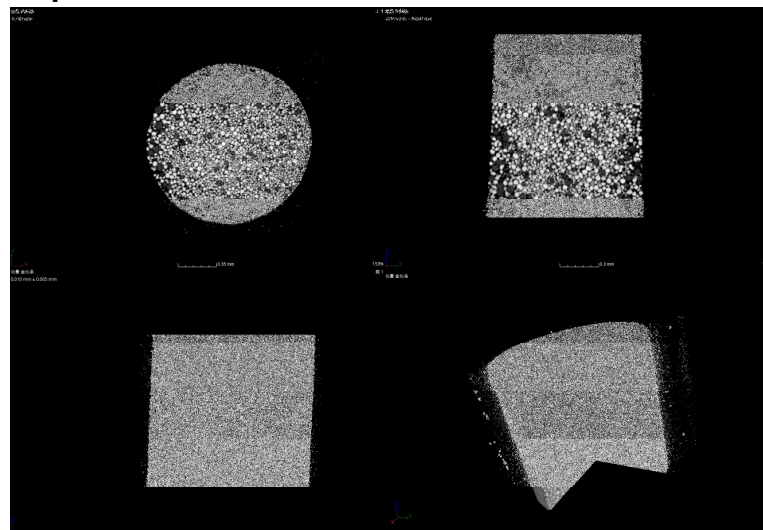
CT application by Horizontal CT

3D Printing by Metal powder



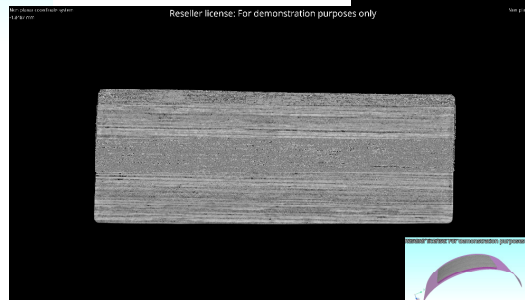
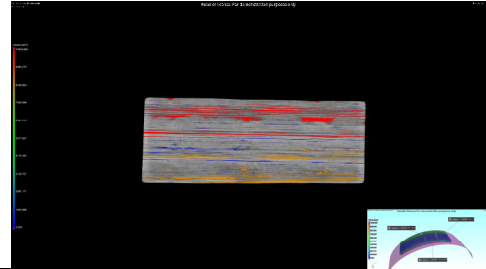
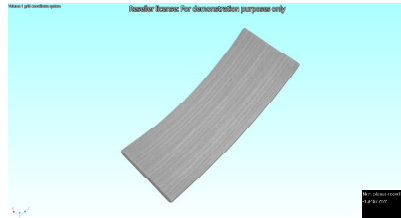
CT application by Horizontal CT

Metal powder inspection



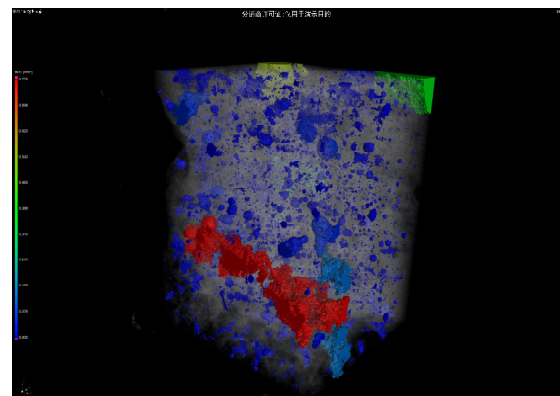
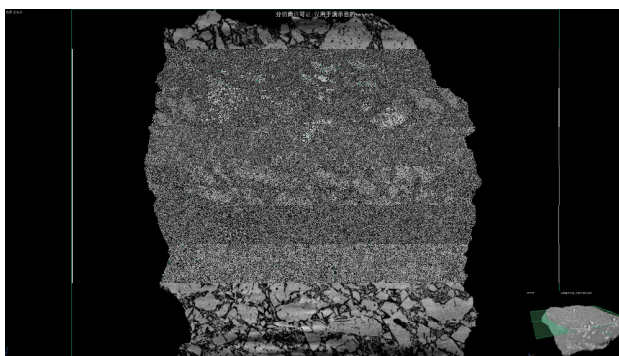
CT application by Horizontal CT

Ceramic Fiber inspection



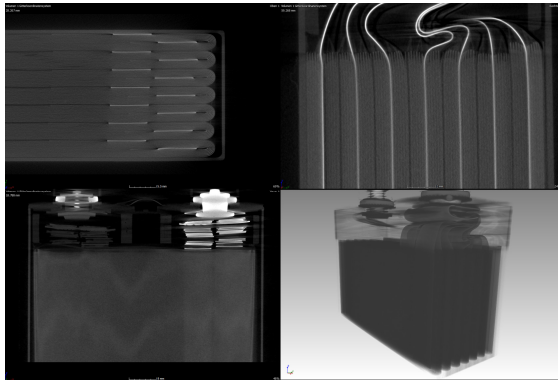
CT application by Horizontal CT

Stone inspection



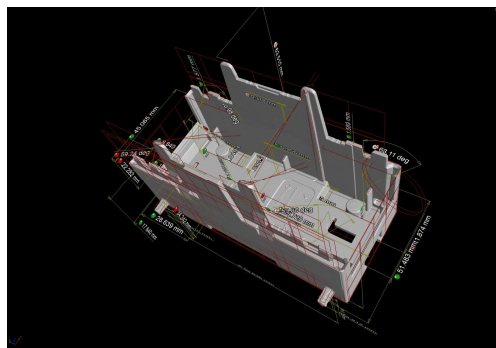
CT application by Horizontal CT

Li- battery for electronic inspection

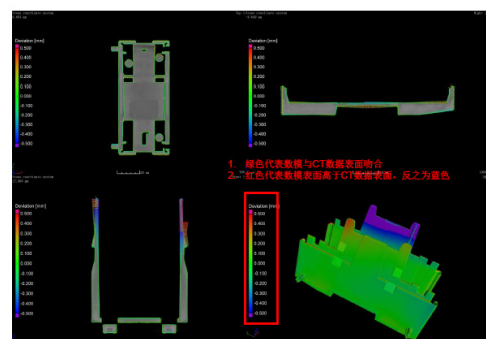


CT application by Horizontal CT

Plastic cover metrology inspection



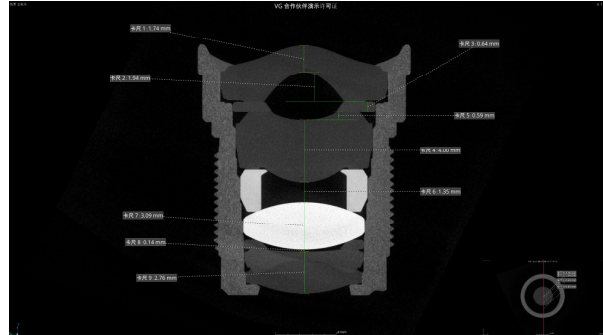
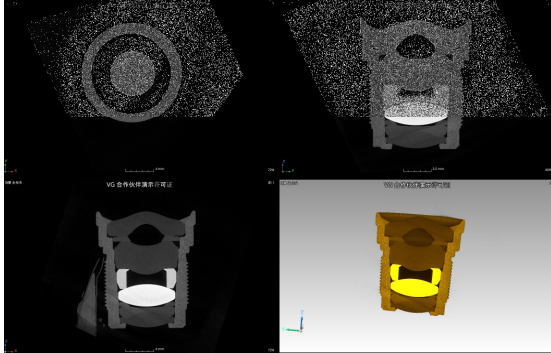
coordinate measurement



actual/nominal comparison

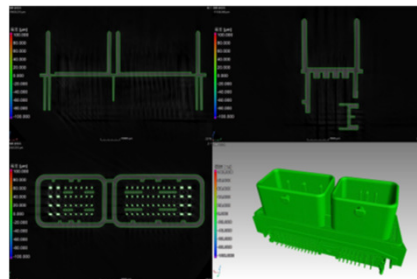
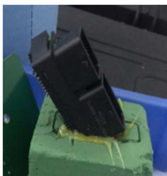
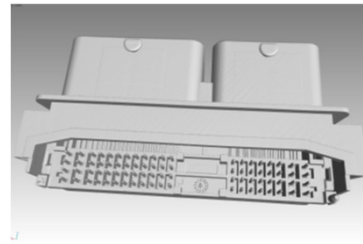
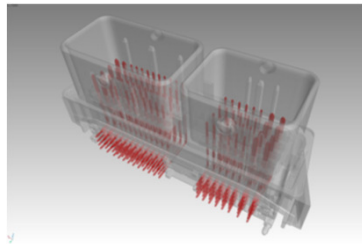
CT application by Horizontal CT

Mobile phone camera inspection



CT application by Horizontal CT

Industrial power plug inspection



Agenda

- Company introduce
- Basic knowledge of X-ray
- 2D X-ray inspection and application
- CT (Computer Tomography) basic knowledge and application
- Step further in CT
- Horizontal CT and application
- **Laminographic CT (PCT) and application in advance IC's package**
- AI technology developing in CT

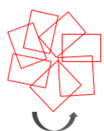
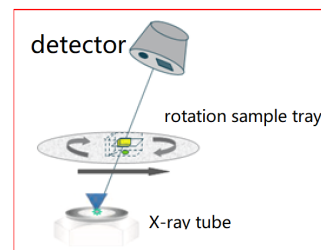
Laminographic CT (Planer CT)

The key factory of Laminographic CT

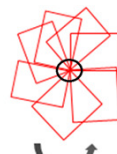
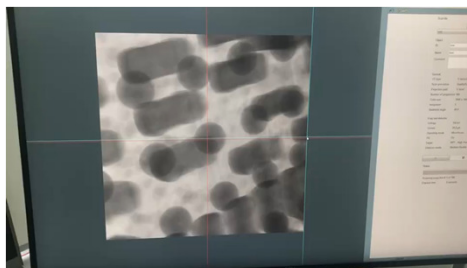
- The precision of mechanical manipulator

Laminographic CT can be distinguish as

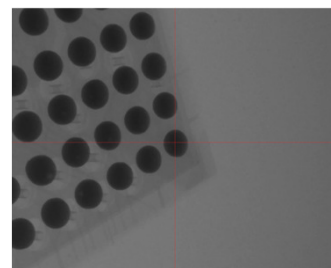
- The second generation PCT
- The third generation PCT



the second
generation PCT



The third
generation PCT



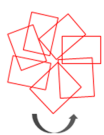
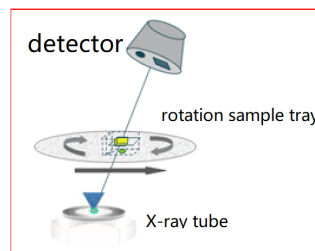
Laminographic CT (Planer CT)

The key factory of Laminographic CT

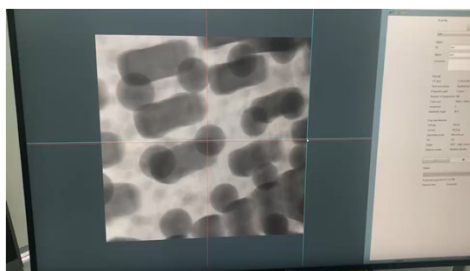
- The precision of mechanical manipulator

Laminographic CT can be distinguish as

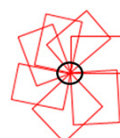
- The second generation PCT
- The third generation PCT



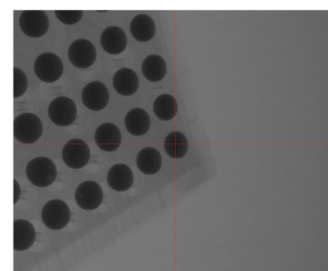
the second generation PCT



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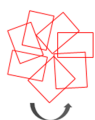
The third generation PCT



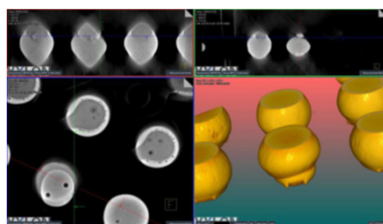
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Laminographic CT (Planer CT)

- Disadvantage of **The second generation PCT**
 - Missing Z axis information Since the worse precision of mechanical manipulator
- Advantage of the **third generation PCT**
 - Z axis information has been collected since the high prevision of mechanical manipulator



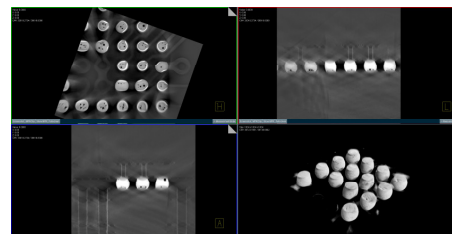
the second generation PCT



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yxlon



The third generation PCT

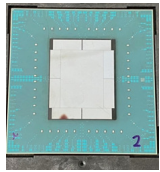


Z axis information is collected , PCT is done by the third generation

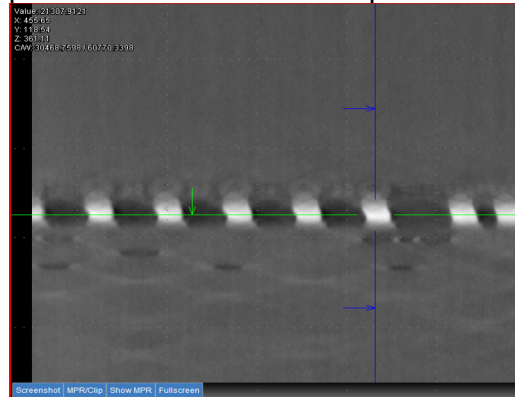
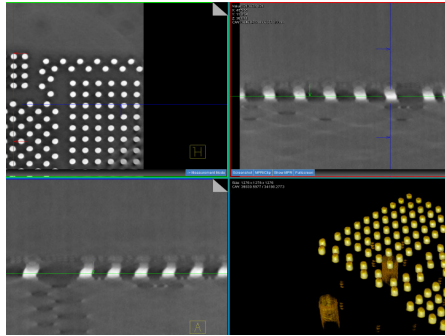
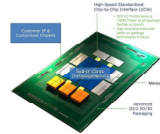
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Application for Advantage Package inspection -----by Third generation PCT

Chiplet ----- **Info Package** – C4 bump inspection– defective : bump shift

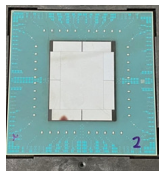


OPEN CHIPLET: PLATFORM ON A PACKAGE

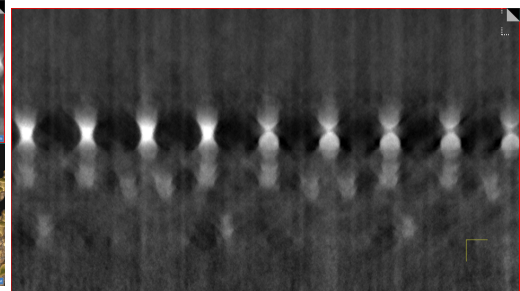
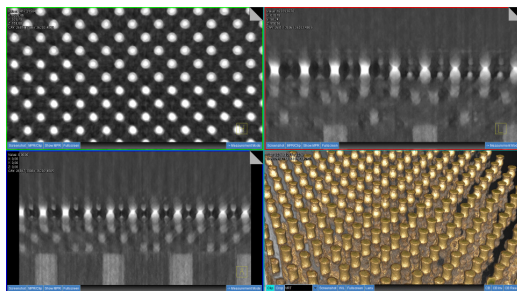
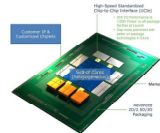


Application for Advantage Package inspection -----by Third generation PCT

Chiplet ----- **Info Package** – C4 bump inspection– defective : Non-wet

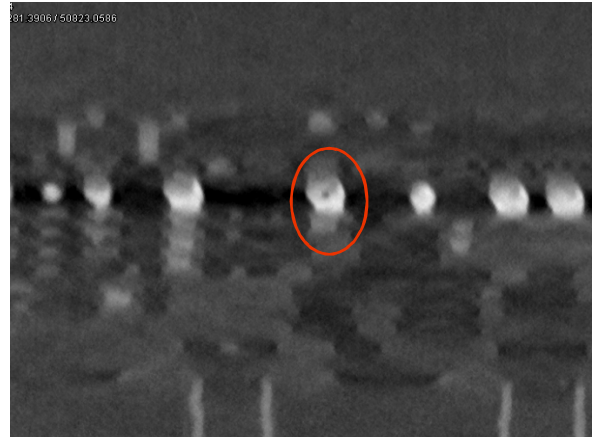
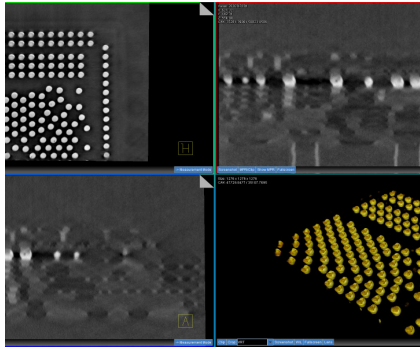
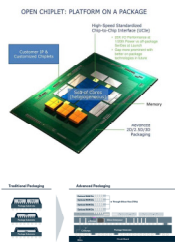
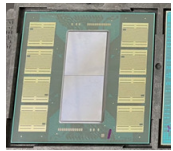


OPEN CHIPLET: PLATFORM ON A PACKAGE



Application for Advantage Package inspection -----by Third generation PCT

Chiplet ----- **COWOS Package** – C4 bump inspection– defective : void

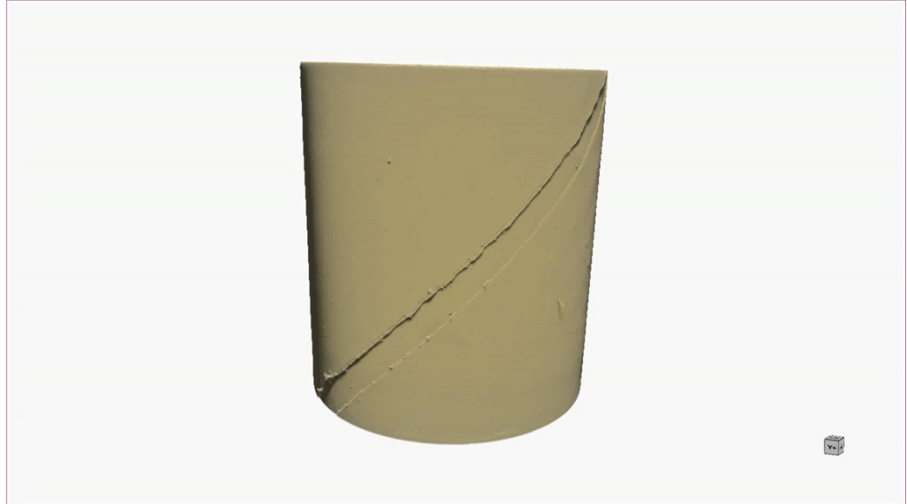


Agenda

- Company introduce
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- **AI technology developing in CT**

AI technology developing in CT

Please see the movie



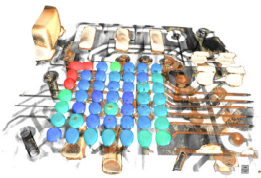
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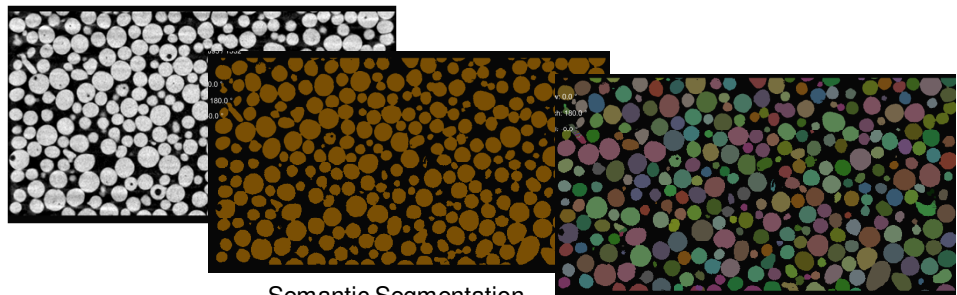
AI technology developing in CT

What is the key during CT data analysis----- Image segmentation

- According to the grey value difference to distinguish difference material in the CT data
- After segmentation being finished, then we can easy to analysis those CT data
- Image segmentation is the classification of each pixel according to the grey value



One of the CT slice (grey value)



Semantic Segmentation

Instance Segmentation



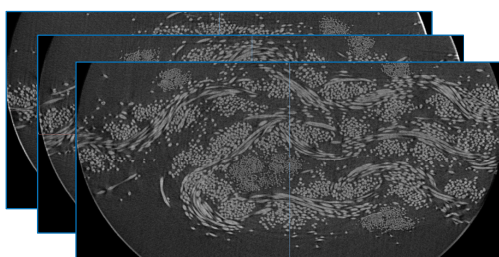
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yxlon

3/5/2024 88

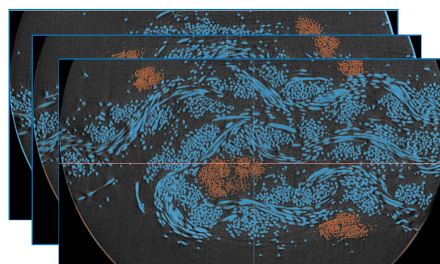
AI technology developing in CT

What is the process to do deep learning during image segmentation ?

Step 1 : select 3 slice of CT data , segment object manually



original CT slice



Segmentation manually

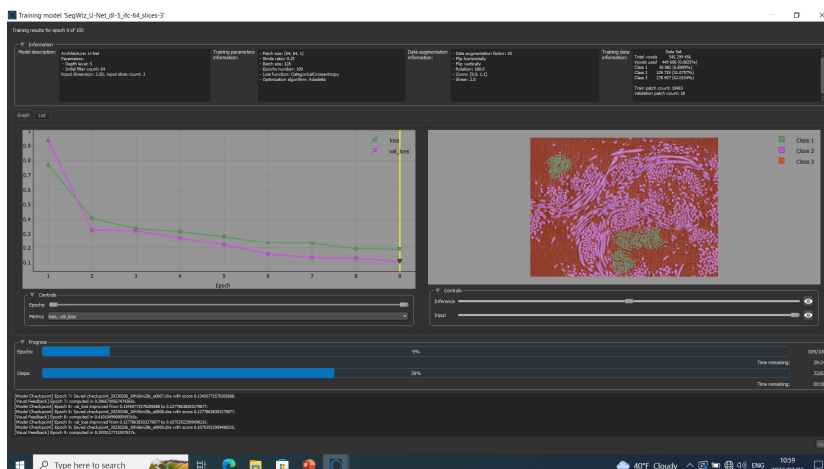


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AI technology developing in CT

What is the process to do deep learning during image segmentation ?

Step 2 : running Image segmentation based on deep learning (neural network model, waiting finishing)



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AI technology developing in CT

What is the process to do deep learning during image segmentation ?

Step 3 : back to step 1, correct the object segmentation manually

Step 4: then go to step 2: Image segmentation based on deep learning (neural network model, waiting finishing

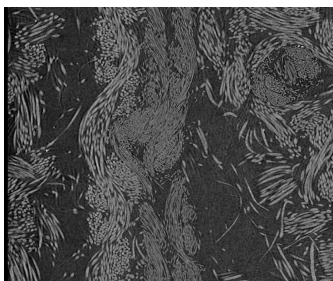
Until the segmentation is correct.



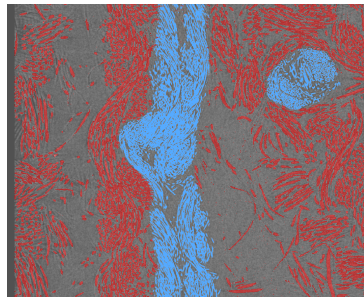
AI technology developing in CT

Application from Image segmentation based on deep learning (neural network model)

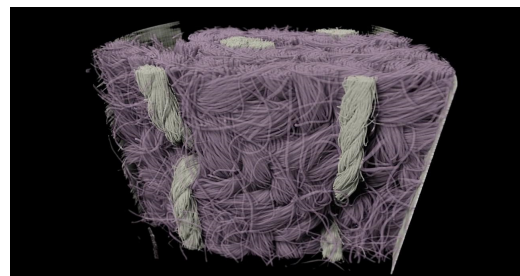
Distinguishing different fibers in fabrics



Original Slice



Segmentation by deeper learning

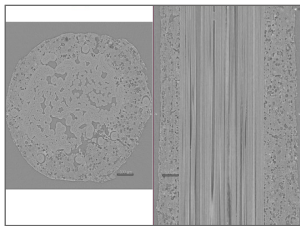


Segmentation in 3D

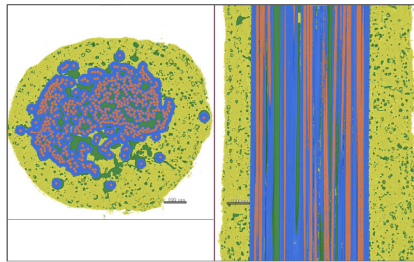
AI technology developing in CT

Application from Image segmentation based on deep learning (neural network model)

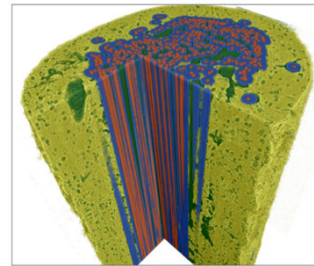
Micron CT Image Analysis of Fiber Reinforced Ceramic Matrix Composite Materials



Original Slice



Segmentation by deeper learning

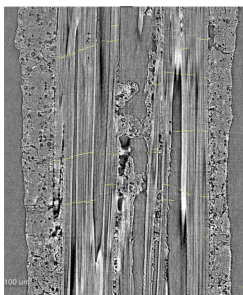


Segmentation in 3D

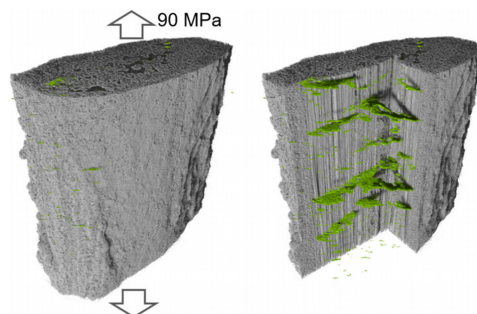
AI technology developing in CT

Application from Image segmentation based on deep learning (neural network model)

Extraction of microcracks generated by in-situ stretching



Original Slice



Segmentation in 3D

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