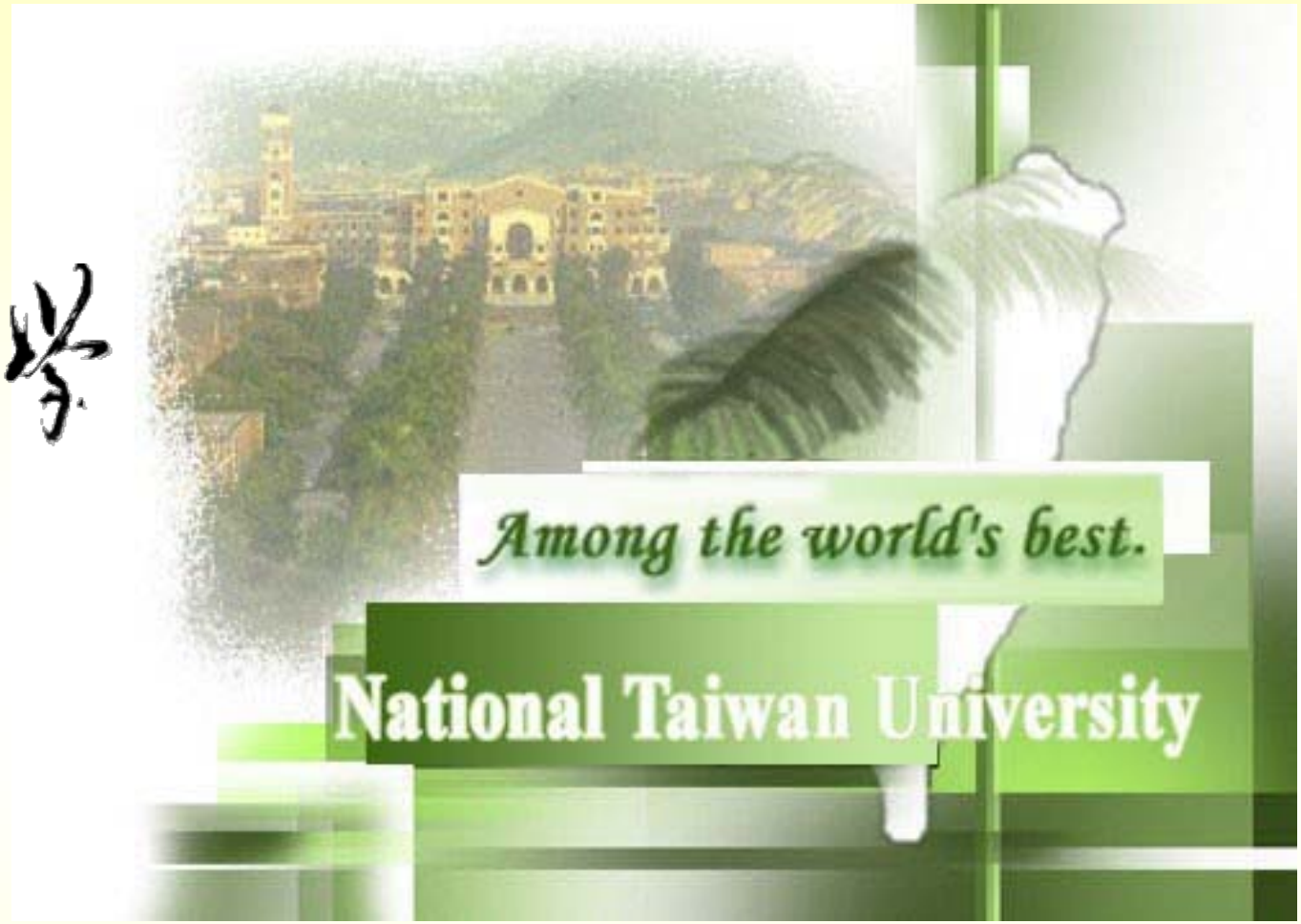
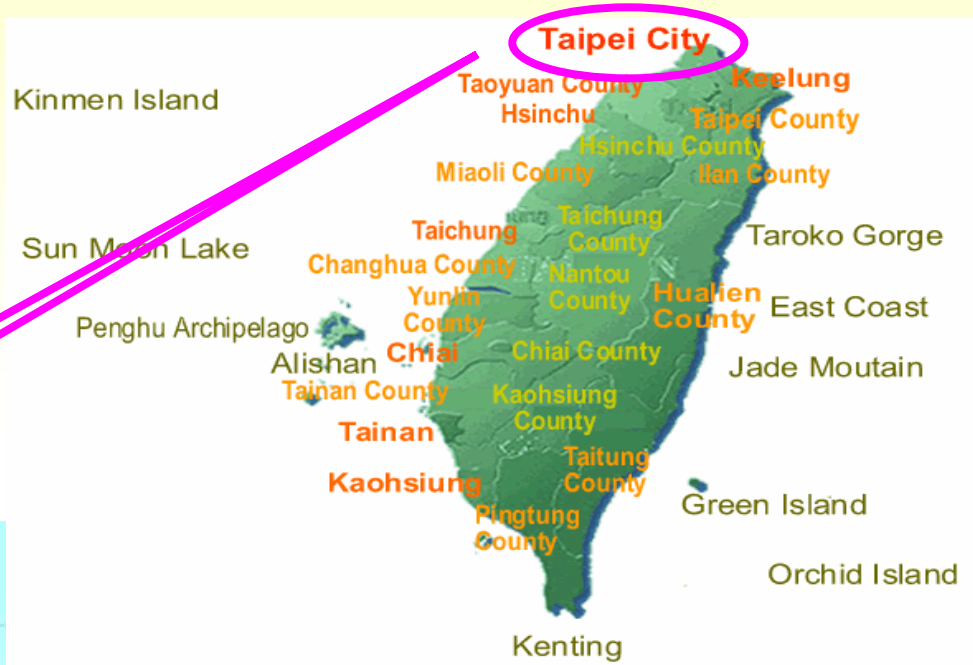


Department of Materials Science & Engineering at NTU

Chairman : Wen-Bin Liau

Location of NTU



A Brief on NTU

Founded in 1928

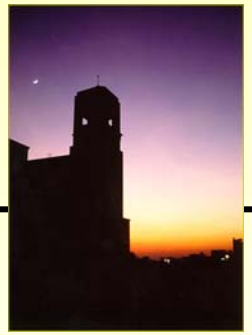
Renamed as the National Taiwan University in 1945

Leading university in this country in almost every aspect

Becoming one of the first-class universities in the world

Statistics of NTU in 2004

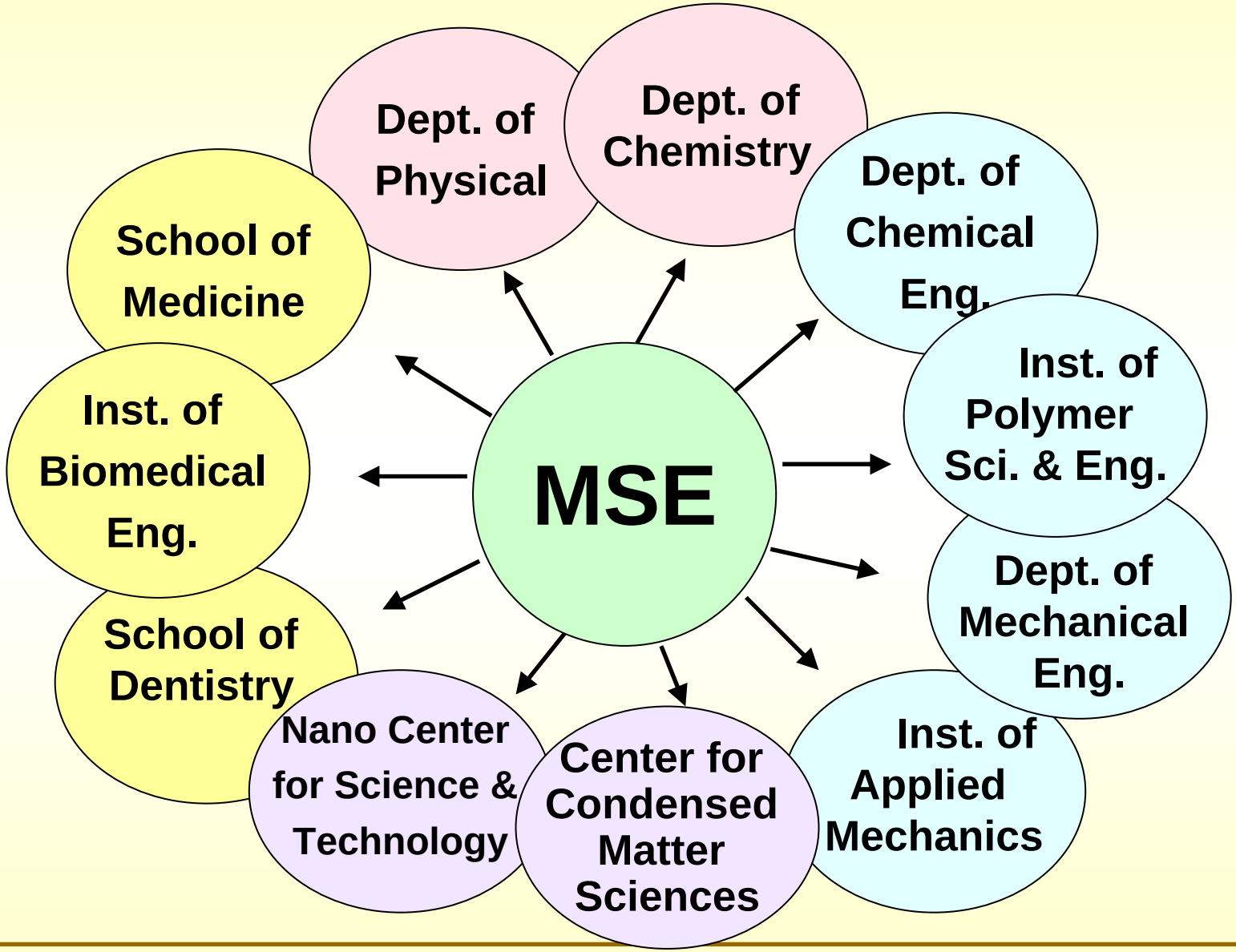
Campus area	34,676 hectare	Taiwan area: 3600,000 hectare (0.98%)	
Academics	11 colleges	54 departments	96 graduate institutes
Faculty	Full-time: 1783	Part-time : 1192	
Students	17,724 Bachelor	9,000 Master	3,853 Doctor
Library	3,000,000 volumes of books		



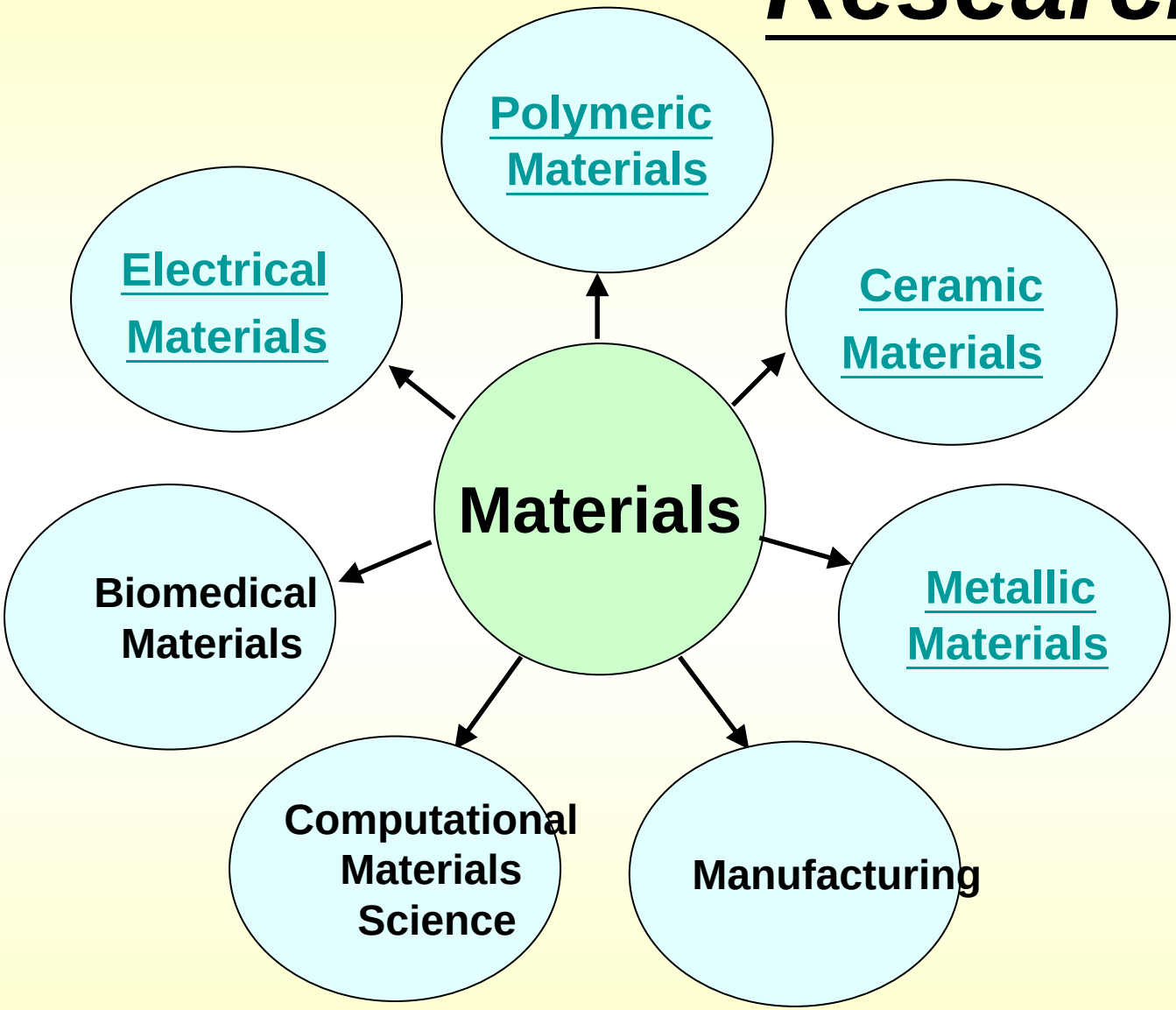
Statistics in 2004

		NTU	Engineering College	Dept. MSE
Academics	colleges	11		
	departments	54	5	
	graduate institutes	96	11	
Faculty	Full-time	1,783	237	24
	Part-time	1,192	65	0
	Total	**2,976**	**315**	**24**
Students	Undergraduate	17,724	1,849	221
	M. S.	9,000	1,695	110
	Ph. D	3,853	947	89
	Total	**30,577**	**4,491**	**420**

Relative Depts. & Inst.



Research Field



Electrical Materials

- Novel Nanostructured Silicon Electrical and Light-Emitting Devices
- Manufacturing and Reliability Analysis of Pb-free Solders Ball Grid Array Package
- Manufacturing of High Efficiency Al/Cu Hear Dissipaters for the Cooling of System Components
- Influence of Rare Earth Element Addition on the Interfacial Reaction and Dynamic Fatigue of Sn-Ag-Cu-X (X=Ni, Sb, Bi) Solder Joint in GA Package
- Electronic structures and Optical Properties of Quantum Dolts Nanowires by the First Principles Calculation
- Organic/inorganic Hybrid Materials in the Photovoltaic Application

Back to **research field**

Polymeric Materials

- A Study on Polymeric Light Source with High Quantum Efficiency (II)
- High Quantum Yield Pled Devices Based on MEH-PPV/DPO-PPV Polyblends
- Synthesis-Structure-Properties-Applications Relationships of Nano-Composites Based on Conjugated-Co-Nonconjugated Block Copolymers
- Application Of Atomic Layer Deposition in Flexible and Rigid OlED Displays: Encapsulation and Buffer Layers
- Interfacial Ultra-Thin Ceramic/Metal Films by Atomic Layer for Improving the Electroluminescent Efficiency of Organic Light-Emitting Diodes

Back to **research field**

Ceramic Materials

- Microstructural Analysis of Barium Titanate Ceramics with aliovalent elements
- Synthesis of Sealing Glasses and Property Analysis of Cell Interface of Solid Oxide Fuel Cell
- Nano-Photonic Circuitry
- The Novel Fluoeinated Poly(arylene) based Proton Exchange Membranes for PEMFC
- The Actuating, Sensing, and Cracking Behavior of Lead-free Ferroelectric Ceramics
- Development of Multi-functional Zirconia Matrix Composites (II)

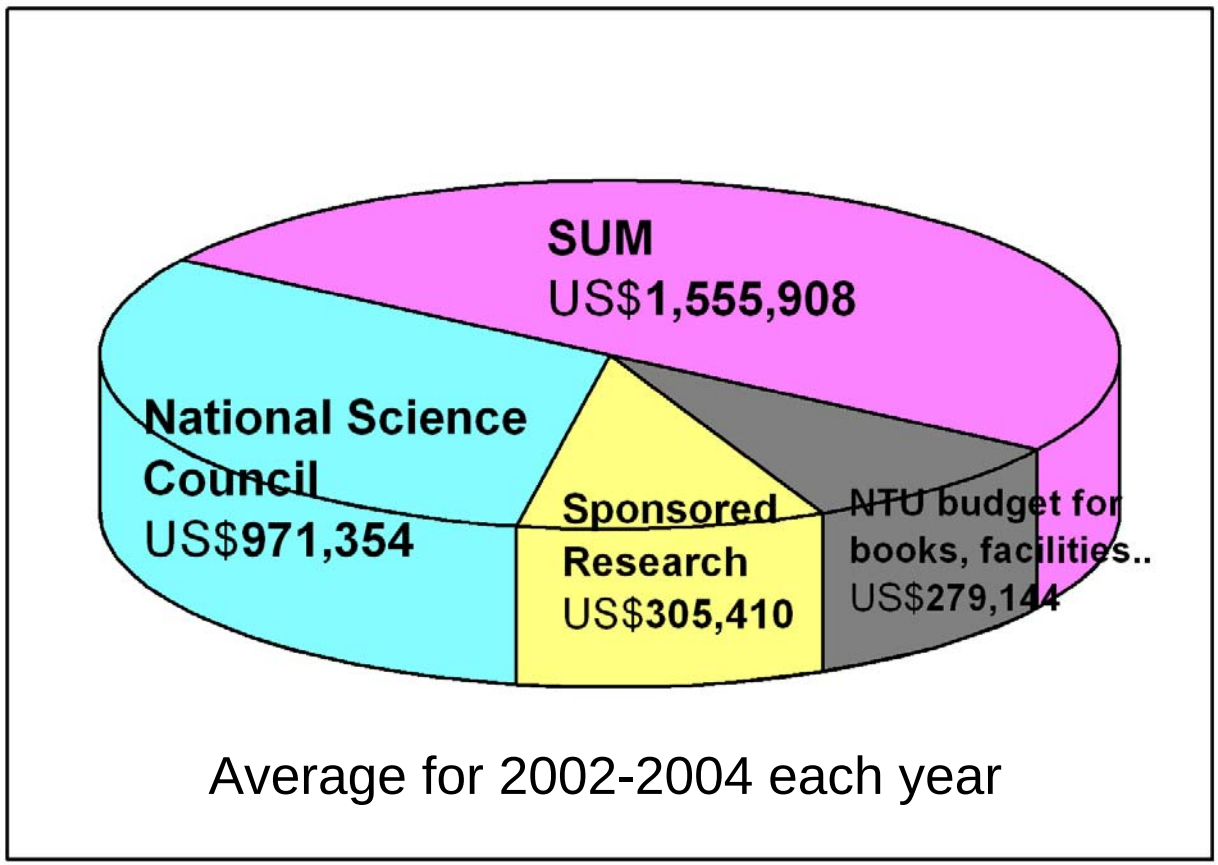
Back to **research field**

Metallic Materials

- The Effect of Heat-Treatment on the Microstructures and Mechanical Properties of Ultrahigh-Strength Ni-Cr-Mo Steel
- A Study on TiNi Shape Memory Alloy For Use in Coronary Stent
- A Study on TIG Welding and Diffusion Bonding as well as Superplastic Forming of Magnesium Alloys
- The Study and development of silver assistant electrode with high durability for transparent conductive thin film ITO-Ag alloy-ITO
- Process Development of Laser-surface thin film Deposition
- Laser Welding of Duplex Stainless Steel with Nitrogen Additions
- Study on the Nano-sized Precipitation of High Strength Hot Rolled Steel Sheets
- The Microstructure Development in Fe-0.2C-1.5Si-1.5Mn TRIP Steel
- Investigation on Nano-structures of low Temperature Bainite and it's Tempering Behavior
- Studies on The Novel Fe-based Shape Memory Alloys (I~III)

Back to **research field**

Research funding for MSE



Average for 2002-2004 each year

Lab. & Facilities at MSE

- Electron Microscope Lab.
- Material Lab.
- Thermal Analysis Lab.
- X-Ray diffraction & Composition Analysis Lab.
- Metallographic Lab.

Electron Microscope Lab.

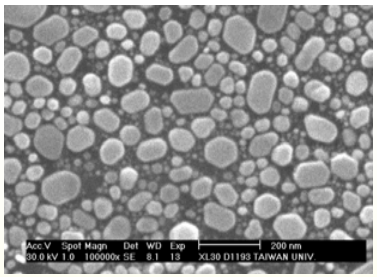
- SEM
- SEM + EDS
- FEG-SEM + EDS
- TEM
- STEM + EDS
- FEG-TEM + EDS
- Electron Probe X-Ray Microanalyzer，EPMA (JEOL JXA-8200SX)

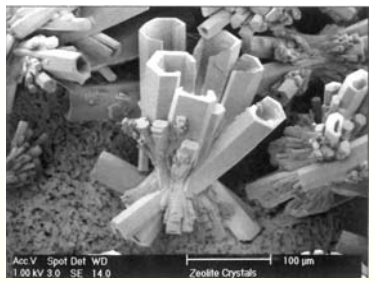
SEM + EDS

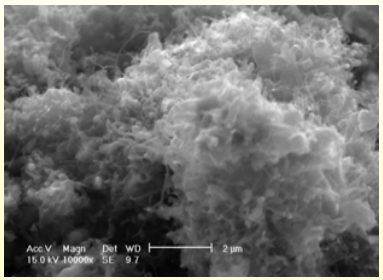
- Source: tungsten filaments (k type)
- Image: (1) secondary electrons
  (2) backscattered electron
- Application:

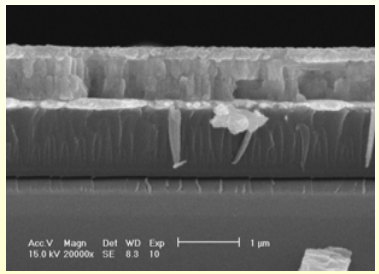
(1) SEM: Microstructural Characterization

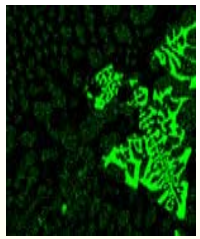
(2) EDS : composition analysis

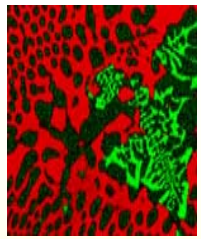


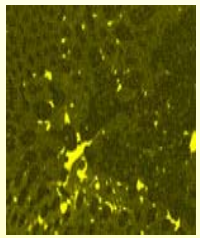


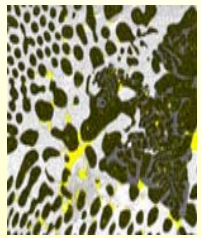








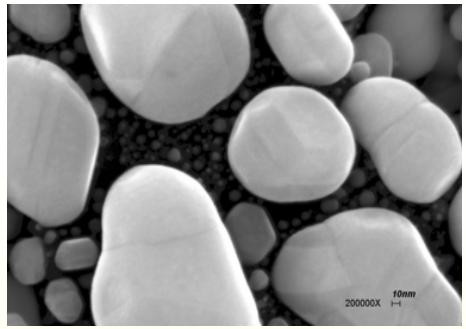


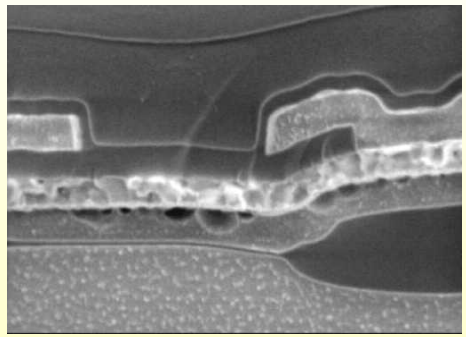


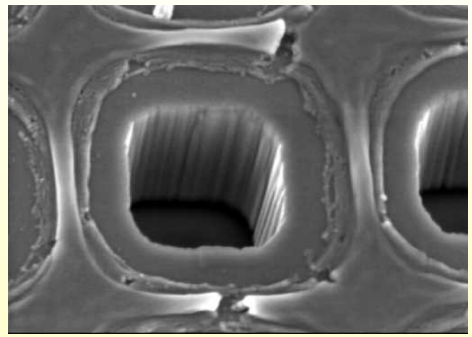
FEG-SEM + EDS

- Source: field emission gun
- Image:
  (1) secondary electrons
  (2) backscattered electron
- Application:
  (1) SEM:
  - High-resolution of Microstructural Characterization,
  - Low-voltage of microstructure observation

  (2) EDS : composition analysis
- Scanning : Line profile, Mapping







TEM

- Source: tungsten filaments (k type)
- Energy: 100 kV
- Image:
  (1) bright field
  (2) dark field
- Application:
  (1) Diffraction Pattern:
  Microstructural Characterization

明 視 野 像

暗 視 野 像

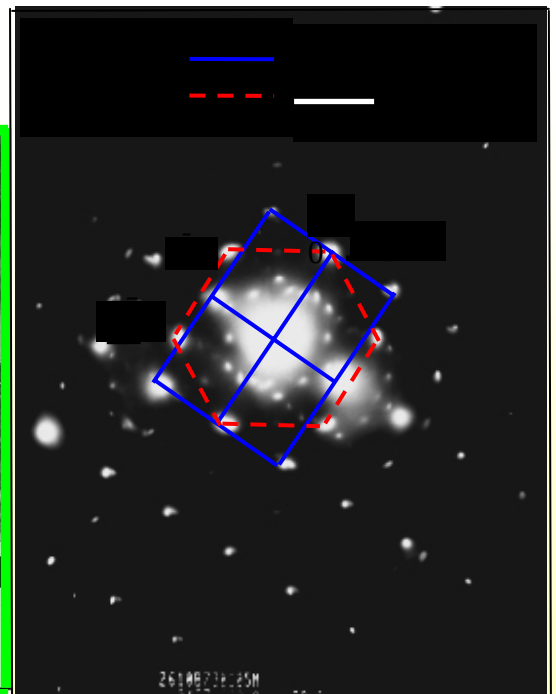
STEM

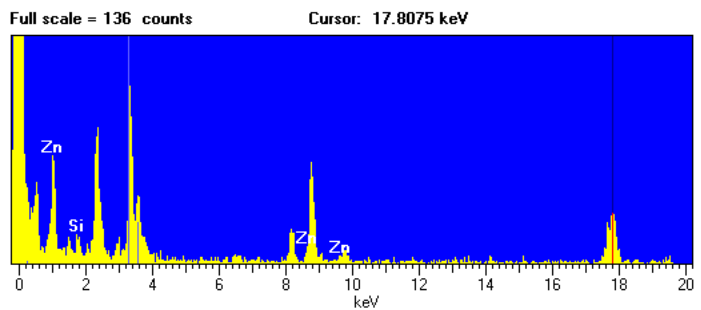
- Source: LaB_6
- Energy: 200 kV
- Image: (1) bright field
  (2) dark field
- Application:

(1) Diffraction Pattern:

Microstructural Characterization

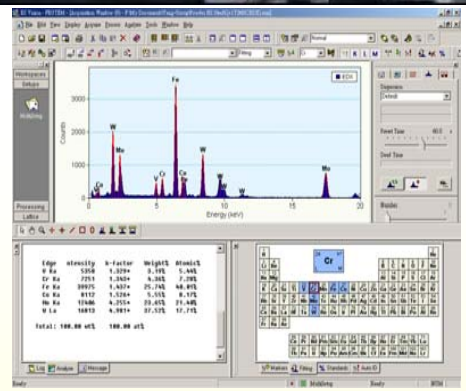
(2) EDS: composition analysis

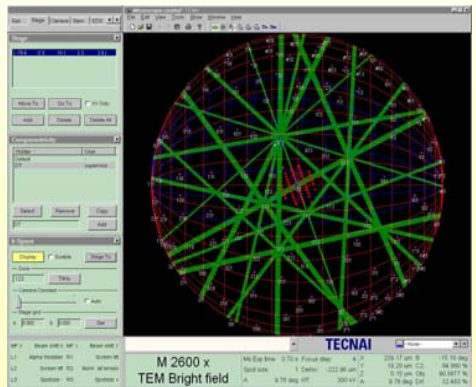


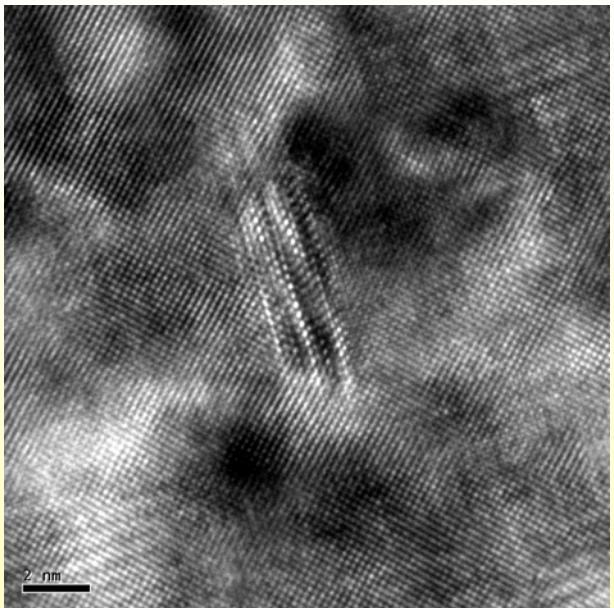


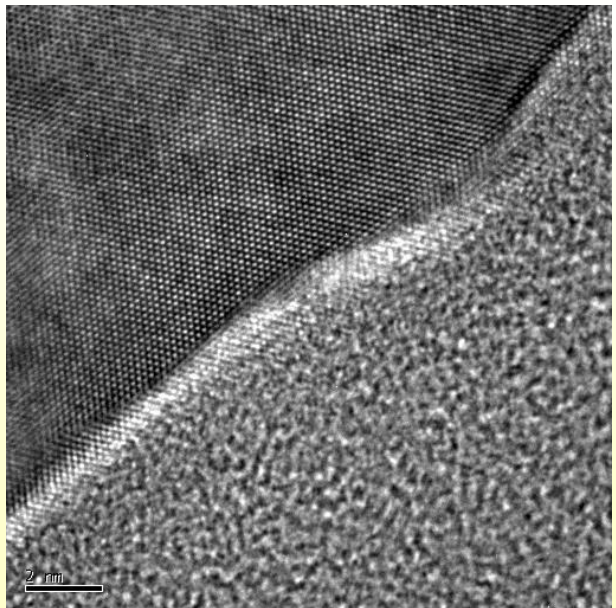
FEG-TEM + EDS

- Source: field emission gun
- Energy: 300 kV
- Advantages: (1) STEM high-resolution image
  (2) obtain lattice image
  (3) electron beam converges on 1nm
  → offer finer-area diffraction patterns
  → offer better energy resolution
  → precise EDS composition analysis
  (4) smaller converge angel
  → offer clearer converged electric diffraction images
  → benefit 3D-spatial crystal structure analysis





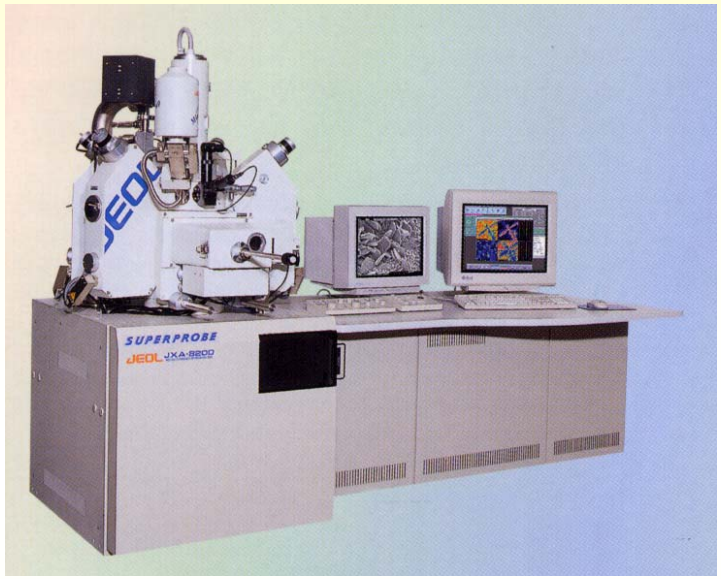


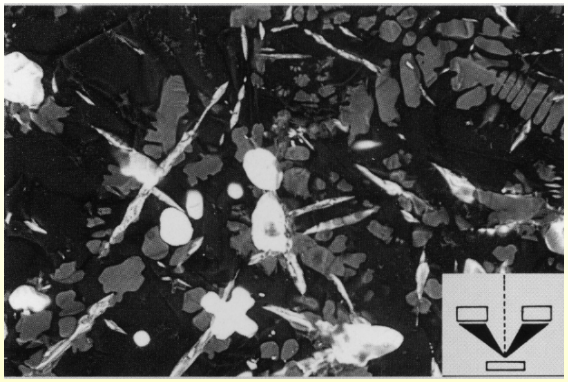


EPMA

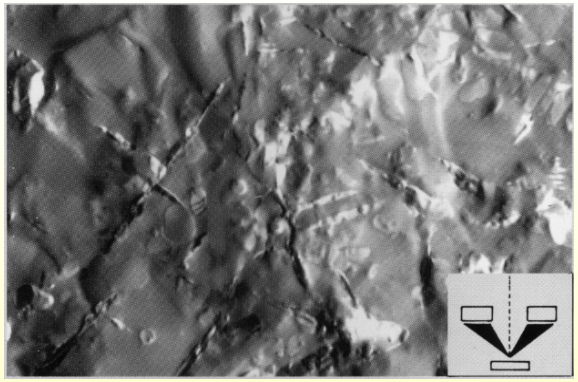
- Source: tungsten filaments (k type)
- Image: (1) SEI
  (2) BEI
- Application:

  Composition analysis: qualification, quantitation, chemical compositon
- Scanning : Line profile, Mapping
- Two channels

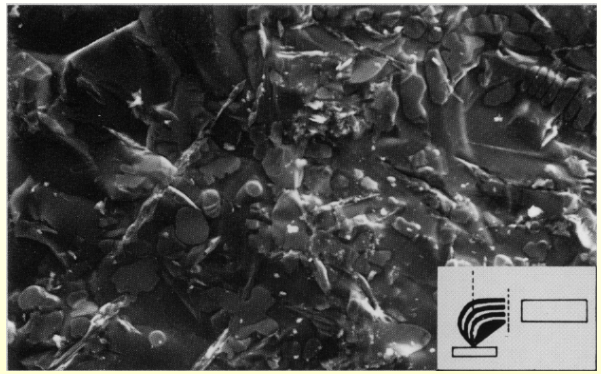




SEI



BEI(Composition)



BEI(Topography)

EPMA + EDS

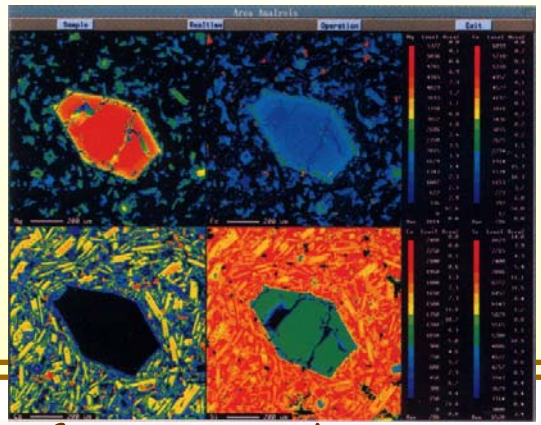
- Source: LaB_6
- Image: (1) SEI
  (2) BEI
- Application:

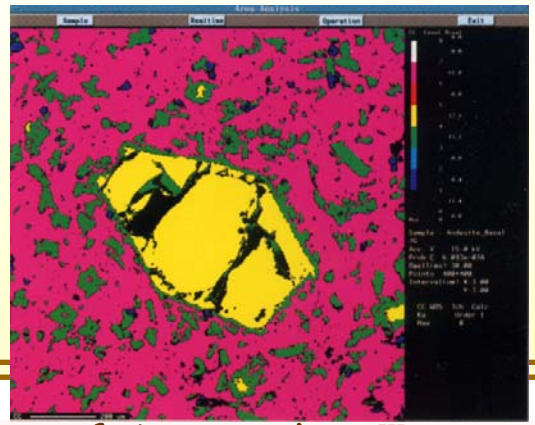
  Composition analysis:

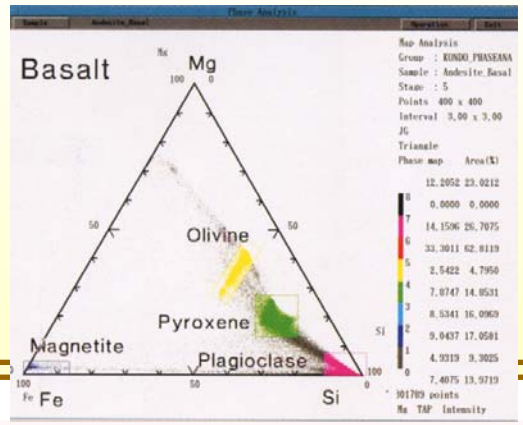
  -qualification,

  -quantitation,

  -chemical composition
- Scanning : Line profile, Mapping
- Four channels







Material Lab.

- MTS
- Impact Tester
- Hardness Tester

MTS

- Application:
  - Ultimate tensile stress (UTS)
  - Bending stress
  - S-N curve threshold of fatigue limit

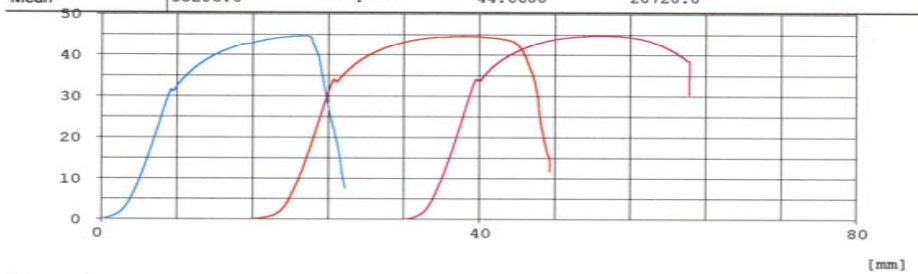
ntu

Batch Name:

Shape: Plate

Gauge Length: 200.00

Calc.	YP-Load	YS1-Load	Max-Load	Break-Load
CP1, CP2	0.100	0.000		
CP Unit	[%/Fullscale]	[%]		
Pass-Fail	-.--, -.--	-.--, -.--	-.--, -.--	-.--, -.--
Unit	[kgf]	[kgf]	[tf]	[kgf]
1	31600.0	---.---	44.6200	8820.00
2	34040.0	---.---	44.6000	14900.0
3	34220.0	---.---	44.7600	38440.0
Mean	33286.6	---.---	44.6600	20720.0



Comment:

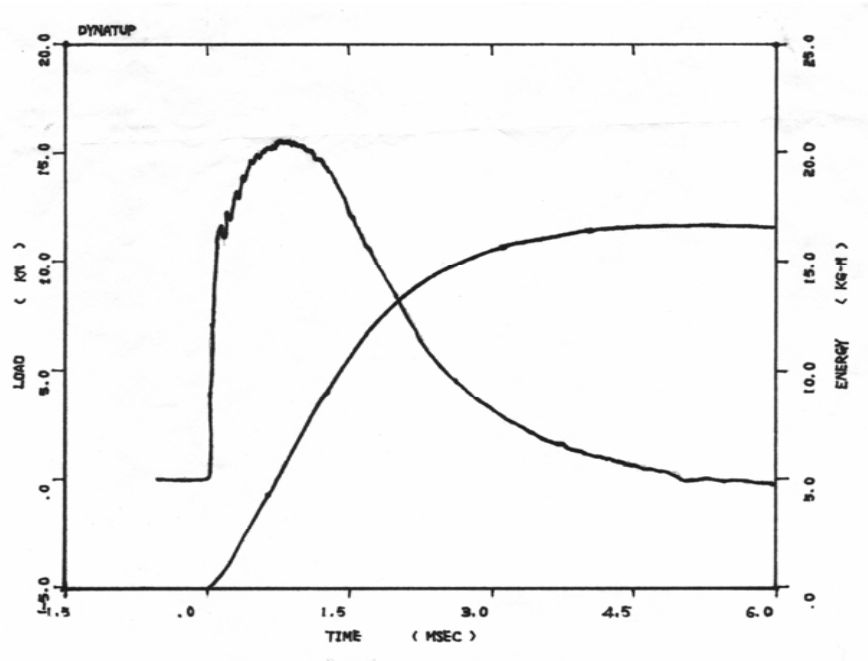
Impact Tester

- Application:

  Detect impact energies in

  (1) room temperature

  (2) low temperature



Hardness Tester

- Application:
  - Brinell hardness test
  - Rockwell hardness test
  - Vickers hardness test
  - Shore hardness test

```
*** IDENTITY ***
DATE :90/11/22
NAME :BK  BBm
LOT  :0001
TOTAL:05
LOAD :150 kg
INDNT: DIAMOND

*HARDNESS VALUE*
>N   HRC
>01  61.4
>02  61.3
>03  60.7
>04  61.0
>05  61.4

** STATISTICS **
     MAX =  61.4
     MIN =  60.7
   RANGE =   0.7
ACQUISION=    05
 AVERAGE = 61.16
```

Thermal Analysis Lab.

- **Thermal Analysis Facilities:**

  -TGA

  -DSC

  -DTAD

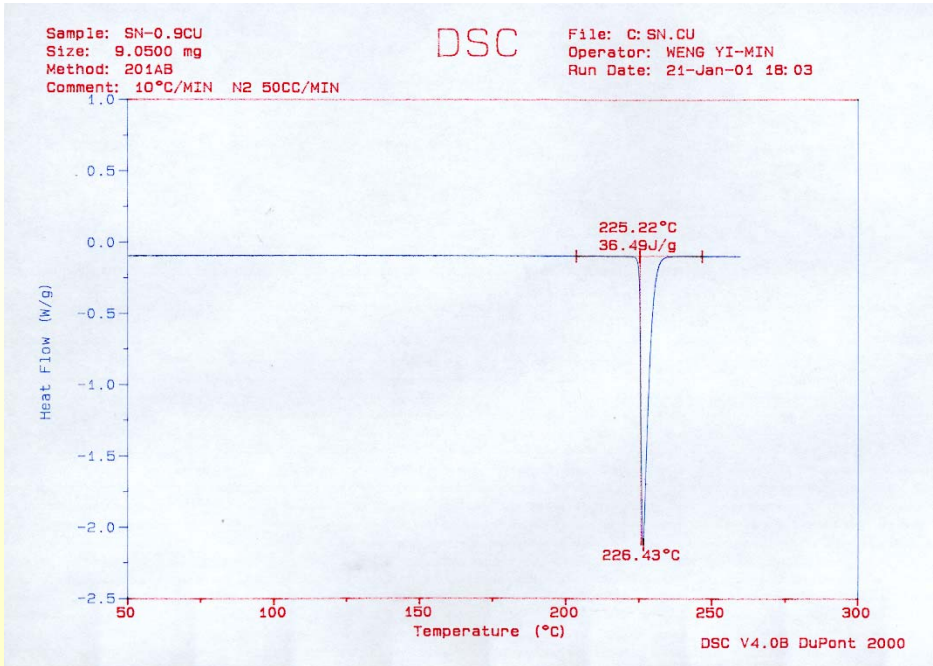
  -DMA

- **Carbon/Sulfur Determinator**

- **Oxygen/Nitrogen Determinator**

Thermal Analysis Facilities

- Differential Thermal Analysis （ DTA ）
- Differential Scanning Calorimetry （ DSC ）
- Thermogravimetric Analysis （ TGA ）
- Themomechanical Analyzer （ DMA ）



Carbon/Sulfur Determinator

- Application:

  - Detect the quantity of carbon and sulfur in materials

Oxygen/Nitrogen Determinator

- Application:

  - Detect the quantity of oxygen and nitrogen in materials

X-Ray Diffraction Analysis Lab.

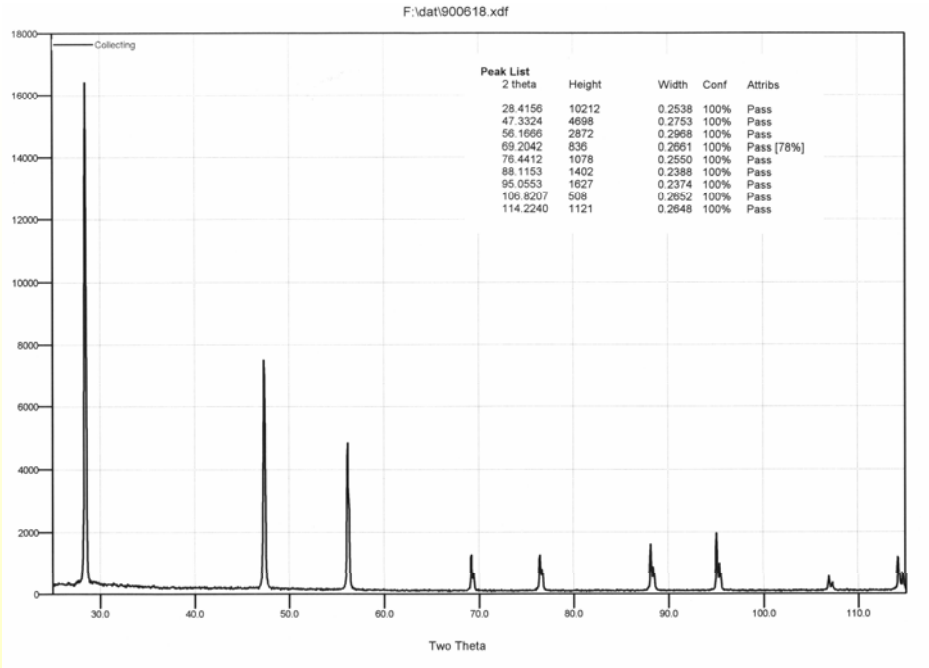
- XRD
- Spectrometer

XRD

- Application:

  - (1) Determine the miller index of each diffraction peak

  - (2) Determine the crystal structure of materials, according to JCPDS cards.



  - (3) Calculate the lattice constants of an unknown-materials

Spectrometer

- Application:

  - Determine the compositions of the
    (1) iron-carbon alloys
    (2) copper alloys
    (3) aluminum alloys

** CONT ** AN= 29 TAN=2524 11-20-01 09:19
AG-No:LA-ST ST-No.: [900633]-[1]

	Fe1	C	Si1	Mn2	P	S	Ni1	Cr1
N= 1	.63260	.12923	.25321	.87608	.01710	.00717	.01863	.02448
N= 2	.63340	.13038	.25281	.87184	.01702	.00691	.01783	.02440
AVE	.63300	.12980	.25301	.87396	.01706	.00704	.01823	.02444

	Mo1	Cu2	Al1	V	Nb	V+Nb	CE1	CE2
N= 1	.00785	.00822	.03457	.00000	.00000	.00000	.27524	.27867
N= 2	.00694	.00819	.03562	.00000	.00000	.00000	.27568	.27908
AVE	.00739R	.00820	.03510	.00000	.00000	.00000	.27546	.27887

Metallographic Lab.

- Microscopes :
  - Stereo microscope
  - multi-function microscope
  - Optical Microscope
- Cutting Machine
- Grinding, Polishing Machine
- Mounting Press Machine

Lab. & Facilities at NTU

- Center for Condensed Matter Sciences
- Nano Center for Science and Technology
- The Instrument Center of Science College

  (funded by National Science Council)

NTU will get extra budget, US$ 100,000,000/year,

from government in next five consecutive years.

An example for international cooperation in experiment at MSE, NTU

Date : Wen, 17 Aug 2005 09:57

An research scholar asked to do some experiment in DSC / DTA.

I got samples by air mail at Fri, 16 Sep 2005.

Wed, 28 Sep 2005, he received the results through the e-mail.

How to reach us?

- Email to Dept. of Mater. Sci. & Eng.
  at Natl. Taiwan Univ.
  → msentu@ntu.edu.tw

- Email to chairman of Dept. of Mater. Sci. & Eng.
  → wbliau@ntu.edu.tw

Transportation to NTU

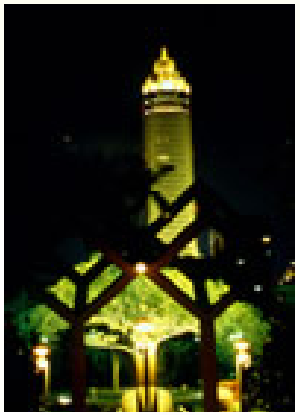
CKS International Airport

↓ Bus for 50 mins

Taipei Railway Station

↓ Metro for 10 mins

National Taiwan Univ.



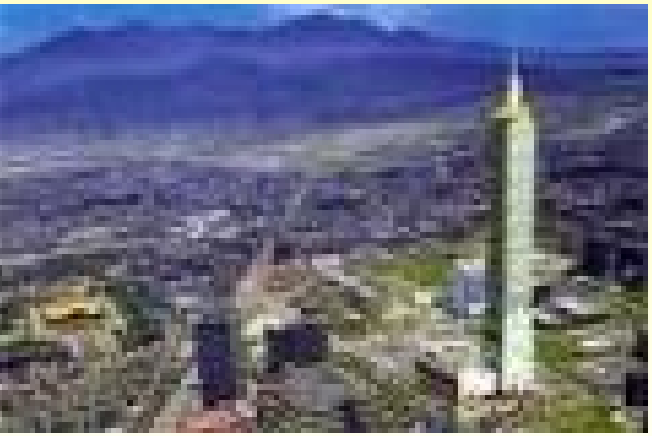
Living in NTU

Living in NTU

Location of NTU

National Taiwan University

Dept. of Mater. Sci. & Eng.









龍山寺
普濟眾生

Taipei 101

Thank you for your attention

Colleges in NTU

- Liberal Arts
- Science
- Social Sciences
- Medicine
- Engineering
- Bio-Resources & Agriculture
- Management
- Public Health
- Electrical Eng. & Computer Scienc
- Law
- Life Science