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

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus area</td>
<td>34,676 hectares</td>
</tr>
<tr>
<td></td>
<td>Taiwan area: 3600,000 hectares (0.98%)</td>
</tr>
<tr>
<td>Academics</td>
<td>11 colleges</td>
</tr>
<tr>
<td></td>
<td>54 departments</td>
</tr>
<tr>
<td></td>
<td>96 graduate institutes</td>
</tr>
<tr>
<td>Faculty</td>
<td>Full-time: 1783</td>
</tr>
<tr>
<td></td>
<td>Part-time: 1192</td>
</tr>
<tr>
<td>Students</td>
<td>17,724 Bachelor</td>
</tr>
<tr>
<td></td>
<td>9,000 Master</td>
</tr>
<tr>
<td></td>
<td>3,853 Doctor</td>
</tr>
<tr>
<td>Library</td>
<td>3,000,000 volumes of books</td>
</tr>
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</table>
## Statistics in 2004

<table>
<thead>
<tr>
<th></th>
<th>NTU</th>
<th>Engineering College</th>
<th>Dept. MSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>colleges</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>departments</td>
<td>54</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>graduate institutes</td>
<td>96</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td><strong>Faculty</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>1,783</td>
<td>237</td>
<td>24</td>
</tr>
<tr>
<td>Part-time</td>
<td>1,192</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,976</td>
<td>315</td>
<td>24</td>
</tr>
<tr>
<td><strong>Students</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Undergraduate</td>
<td>17,724</td>
<td>1,849</td>
<td>221</td>
</tr>
<tr>
<td>M. S.</td>
<td>9,000</td>
<td>1,695</td>
<td>110</td>
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<tr>
<td>Ph. D</td>
<td>3,853</td>
<td>947</td>
<td>89</td>
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<tr>
<td><strong>Total</strong></td>
<td>30,577</td>
<td>4,491</td>
<td>420</td>
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</tbody>
</table>
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 Dots Nanowires by the First Principles Calculation
- Organic/inorganic Hybrid Materials in the Photovoltaic Application
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
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 Fluorinated 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)
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

- National Science Council: US$971,354
- Sponsored Research: US$305,410
- NTU budget for books, facilities: US$279,144

SUM: US$1,555,908
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)
• 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
- Source: tungsten filaments (k type)
- Energy: 100 kV
- Image:
  1. bright field
  2. dark field
- Application:
  1. Diffraction Pattern:
      Microstructural Characterization
• 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
• Source: tungsten filaments (k type)
• Image: (1) SEI
   (2) BEI
• Application:
  Composition analysis: qualification, quantitation, chemical composition
• Scanning: Line profile, Mapping
• Two channels
• 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
- Ultimate tensile stress (UTS)
- Bending stress
- S-N curve threshold of fatigue limit
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
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)
- Thermomechanical 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
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

NTU main campus

Walk for 10 mins

Leader Hotel-Taipei
Living in NTU

- Taipei main station
- Metro for 10 mins
- Howord Hotel
- Walk for 10 mins
- Chunghsiao Fuhsing station
Location of NTU

National Taiwan University
Dept. of Mater. Sci. & Eng.
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