Japanese Nonferrous Metals Industry
Developments and Market Outlook

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2. Size of Japanese Nonferrous Metals Markets
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Overview of Japanese Economy

- Nominal GDP of Japan was 4.9 trillion dollars in 2016 and ranked No. 3 in the world after U.S. and China. Our GDP per capita was US$38,000 in 2016.
- Japanese economy hit the bottom in November 2012 and then shows a continuing modest recovery.
- The real growth rate in FY 2017 is estimated to be about 1.5%.
- Potential downturn risks are unpredictable factors including slowdown of the global economy, greater geopolitical risk and downturn of Chinese economy.

Economic figure in Japan

<table>
<thead>
<tr>
<th>Items</th>
<th>Figure in 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>126 million people</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>4.9 trillion dollars</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>US$38,000</td>
</tr>
<tr>
<td>Current balance</td>
<td>191 billion dollars</td>
</tr>
<tr>
<td>Foreign currency reserves</td>
<td>1.2 trillion dollars</td>
</tr>
<tr>
<td>Export to China</td>
<td>109 billion dollars (No.2)</td>
</tr>
<tr>
<td>Import from China</td>
<td>161 billion dollars (No.1)</td>
</tr>
</tbody>
</table>

(Note) Import from China is 2015
(Source) HP of MFA

Size of Japanese Nonferrous Metal Markets

- The Japanese nonferrous metal demand are all ranked high in the world. For example, copper demand in Japan is ranked No.4.

Global share of Nonferrous Metals Demand in Japan and China (2016)

<table>
<thead>
<tr>
<th>Metal</th>
<th>Global demand</th>
<th>Japan share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>973千t (No.4)</td>
<td>4%</td>
</tr>
<tr>
<td>Nickel</td>
<td>162kt (No.2)</td>
<td>9%</td>
</tr>
<tr>
<td>Zinc</td>
<td>470kt (No.6)</td>
<td>3%</td>
</tr>
</tbody>
</table>

(Source) WBMN
The production of respective metals ranks high in the world. World’s leading smelters of these metals in Japan produce high quality metals.

Global share of Nonferrous Metals Production in Japan and China (2016)

**Copper**
- Global production 23,340kt (2016)
- China 36% (No.3)
- Japan 7% (No.7)

**Nickel**
- Global production 1,790kt (2016)
- China 23% (No.2)
- Japan 11%

**Lead**
- Global production 11,141kt (2016)
- China 42%
- Japan 2%

**Zinc**
- Global production 13,648kt (2016)
- China 46%
- Japan 4%

The proportion of Chinese copper demand in the world was dramatically expanded from 13% in 2000 to 50% in 2016. China will keep its driving force to develop the world copper demand in the future.

Change of global share of copper demand

China’s global share expanded to 50%
### Production of Refined Copper in Japan

- The refined copper production in 2016 was 1,553 kt and almost flat these few years. Copper concentrates are all imported from such countries as Chile, Indonesia and Peru.

**Graph:**
- Refined copper production in Japan (1990～2016) in kilotons (kt).
- Import of Copper Conc.:
  - Chile: 42%
  - Canada: 13%
  - Peru: 13%
  - Indonesia: 14%
  - Others: 11%

**Note:**
- Copper Conc. imported to Japan: 1,285 kt (Cu contents)
- Source: METI Statistics

### Consumption of Refined Copper in Japan

- The consumption of refined copper in 2016 was 972 kt, 592 kt (63%) of which was for the wire & cable industry and 325 kt (35%) for the copper and brass industry. 616 kt of refined copper was exported.

**Graph:**
- Demand of Refined copper in Japan (ktpa) for various industries from 1990 to 2016.

**Note:**
- Source: METI's Statistics
**Shipments of Wire & Cable and Copper brass products**

- Shipment of wire & cable was 707kt in 2015. Domestic demand of wire & cable has been stagnant.
- Shipment of copper brass products was 767kt in 2015. The largest demand was the electrical and machinery sector.

![Graph showing Shipments of Wire & Cable and Copper brass products](source)

**Supply and demand of Primary Nickel in Japan**

- In Japan the production of primary nickel was 194kt in 2015, which was 9% increase compared to 2014.
- The consumption of primary nickel was 142kt in 2015, which was 2% increase compared to 2014.

![Graph showing Primary Nickel Production and Consumption in Japan](source)
Supply and Demand of Nickel Metal in Japan

- In Japan electrolytic nickel is produced from nickel matte and mixed sulfide. Production of nickel metal has doubled in the last decade.
- The domestic demand of nickel was 45kt in 2015 and 80% of which was for the specialty steel sector. Export of nickel metal was 32kt.

![Graph showing supply and demand of nickel metal in Japan.]

Supply and Demand of Ferro-nickel in Japan

- The supply has steadily been around 80kt per annum in Japan.
- The major demand is for the stainless steel sector and consequently there is a correlation between production of nickel containing stainless steel and the total demand for ferro-nickel.

![Graph showing supply and demand of ferro-nickel in Japan.]

(Source) METI Statistics
The major demand of nickel is for the stainless and specialty steel, consuming 60 to 70% of supply and the production of stainless and specialty steel has remained relatively stable.

Rate of nickel containing austenitic stainless steel production has slightly decreased in the last 10 years.

Japan procures about 80% of its requirement of raw material in the forms of nickel ore, nickel matte and mixed sulfide.

Import of nickel ore was largely affected by the Indonesian Government's ban on export of unprocessed ore and tonnage lost was replaced by import from the Philippines and New Caledonia.
Refined Zinc Production in Japan

- The refined zinc production in Japan was 534kt in 2016 remaining unchanged these few years. Zinc concentrates are all imported from Bolivia, Australia, Peru, U.S. and Mexico.

Refined Zinc Consumption in Japan

- Domestic consumption of refined zinc in Japan was 354kt in 2016 and this is a big decrease from 818kt at the peak in 1991.
- Galvanized steel sheet with 166kt (47%), other galvanized products with 53kt (15%) and brass products with 47kt (13%). Export was about 81kt in 2016.

(Source) METI Statistics
Refined Lead Production in Japan

- Refined lead production in Japan was 199kt in 2016 and remains mostly level these few years. Lead concentrates are all imported from Australia, the largest importing country, followed by the U.S. and Peru.

![Graph showing production of refined lead in Japan from 1990 to 2016, with data on domestic, imported, scrap, and other sources.](Source) METI Statistics

Lead consumption in Japan

- Refined lead consumption in Japan was 218kt in 2016 and remains flat these few years. Main demand area is storage battery with the consumption of 191kt and 88% of total demand.

![Graph showing supply and demand of electrical lead and secondary lead from 2003 to 2015, with data on export, others, battery, import, secondary lead, and electrical lead.](Source) METI Statistics
History of Copper Smelting Industry in Japan

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World/Japan</td>
<td>● Tokyo Olympic (64)</td>
<td>● Bubble economy (86~91)</td>
<td>● 1st Oil shock (73)</td>
<td>● 2nd Oil shock (79)</td>
<td>● Plaza Accord (85) and Recession by strong-yen</td>
<td>● Resource Super-cycle</td>
<td>● Slowdown of Chinese economy</td>
</tr>
<tr>
<td>MI</td>
<td>● Naoshima (MI Method, 1974)</td>
<td>● Onahama (Mitsubishi, 1965)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nonferrous Metal Smelters in Japan

<table>
<thead>
<tr>
<th>Metal</th>
<th>Number of Smelters</th>
<th>Smelting Capacity</th>
<th>Production (2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>6</td>
<td>1,885</td>
<td>1,553</td>
</tr>
<tr>
<td>Lead</td>
<td>6</td>
<td>291</td>
<td>199</td>
</tr>
<tr>
<td>Zinc</td>
<td>5</td>
<td>655</td>
<td>534</td>
</tr>
<tr>
<td>Nickel</td>
<td>1</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Ferro-Nickel</td>
<td>2</td>
<td>75</td>
<td>54</td>
</tr>
</tbody>
</table>

(Source) MERIJ
Japanese Metal Smelting Companies

Overview of Copper Smelters in Japan

<table>
<thead>
<tr>
<th>Name of smelter</th>
<th>Company’s name</th>
<th>Capacity (ktpa)</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyo</td>
<td>Sumitomo Metal Mining</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>Saganoseki</td>
<td>PPC</td>
<td>450</td>
<td>300</td>
</tr>
<tr>
<td>Hitachi</td>
<td>PPC</td>
<td>ー</td>
<td>225</td>
</tr>
<tr>
<td>Naoshima</td>
<td>Mitsubishi Material</td>
<td>342</td>
<td>234</td>
</tr>
<tr>
<td>Onahama</td>
<td>Onahama Smelting and Refining</td>
<td>354</td>
<td>300</td>
</tr>
<tr>
<td>Tamano</td>
<td>Hibi kyodo</td>
<td>290</td>
<td>290</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,886</td>
<td>1,824</td>
</tr>
</tbody>
</table>

(Note) PPC (Pan Pacific Copper) : JX Nippon Mining & Metals and Mitsu Mining & Smelting
(Source) MERI
Japanese Lead and Zinc Smelters

<table>
<thead>
<tr>
<th>Smelter</th>
<th>Company</th>
<th>Capacity (ktpa)</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hachinohe</td>
<td>Hachinohe Smelting</td>
<td>112 (46)</td>
<td>ISP</td>
</tr>
<tr>
<td>Iijima</td>
<td>Akita Zinc</td>
<td>210</td>
<td>Electrolytic</td>
</tr>
<tr>
<td>Kosaka</td>
<td>Kosaka Smelting &amp; Refining</td>
<td>30</td>
<td>Electric Furnace</td>
</tr>
<tr>
<td>Annaka</td>
<td>Toho Zinc</td>
<td>139</td>
<td>Electrolytic</td>
</tr>
<tr>
<td>Hosokura</td>
<td>Hosokura Metal Mining</td>
<td>24</td>
<td>Blast Furnace</td>
</tr>
<tr>
<td>Kamioka</td>
<td>Kamioka Smelting</td>
<td>72</td>
<td>Blast Furnace</td>
</tr>
<tr>
<td>Hikoshima</td>
<td>Hikoshima Smelting</td>
<td>84</td>
<td>Electrolytic</td>
</tr>
<tr>
<td>Takehara</td>
<td>Mitsui Mining &amp; Smelting</td>
<td>50</td>
<td>Blast Furnace</td>
</tr>
<tr>
<td>Chigirishima</td>
<td>Toho Zinc</td>
<td>107</td>
<td>Blast Furnace</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>617</strong></td>
<td><strong>245</strong></td>
</tr>
</tbody>
</table>

(Note) Lead capacity of Hachinohe is for lead bullion
(Source) MERIJ

Role of Nonferrous Metal Smelters in Japan

- Japanese smelters have an important role not only in recycling but also recovering various kinds of rare metals through mutual treatment.

Recycling and recovering rare metals by mutual treatment between smelters

- Copper Conc.
  - Shredder dust
  - Printed circuit board
  - Waste household electrical appliances, Scrap, etc

- Zinc Conc.
  - Electric furnace dust, Zn oxide
  - Ash

- Refined zinc
  - Cd, In, Ga
  - Sulfuric acid

- Copper smelter
  - Cu sludge
  - Pb sludge
  - Refined Copper
  - Precious metals, PGM, Se, Te, As, Co, Sulfuric acid

- Zinc smelter
  - Zn sludge
  - Cu matte
  - Refined lead
  - Bi, Sb, Sn, Precious metals, Sulfuric acid

- Lead smelter
  - Zn oxide
  - Pb sludge
  - Lead Conc.
  - Battery Pb slag

(Source) MERIJ

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### Japanese Nickel Smelters

<table>
<thead>
<tr>
<th>Smeltera</th>
<th>Company</th>
<th>Capacity (ktpa)</th>
<th>Smelting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyuga</td>
<td>Hyuga Smelting</td>
<td>21</td>
<td>Electric Furnace</td>
</tr>
<tr>
<td>Hachinohe</td>
<td>Pacific Metals</td>
<td>13</td>
<td>Electric Furnace</td>
</tr>
<tr>
<td>Oheyama</td>
<td>Nippon Yakin</td>
<td>41</td>
<td>Rotary Kiln</td>
</tr>
<tr>
<td>Niihama</td>
<td>Sumitomo Metal Mining</td>
<td>65</td>
<td>Matte Chlorine Leaching</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>75, 65</td>
<td></td>
</tr>
</tbody>
</table>

(Source) MERIJ

### Investment in Metal Mines by Japanese Companies

**Nonferrous Metal mines invested by Japanese Metal companies**

- Copper mine
- Zinc/Lead mine
- Nickel mine

(Notes) SMM: Sumitomo Metal Mine, PPC: JX, Mitsui (Mitsui Mining & Smelting)

(Source) MERIJ
Global Mine Development by Japanese Companies

- Japanese companies have been investing in overseas copper mines to secure stable supply of copper ore.

### Investment of Japanese Mining & Smelting Companies in Copper Mines (Before 1999)

<table>
<thead>
<tr>
<th>Copper mine</th>
<th>Country</th>
<th>Start Operation</th>
<th>Japanese companies</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morenci</td>
<td>USA</td>
<td>1987</td>
<td>Sumitomo Metal Mining, Sumitomo Corporation</td>
<td>15%</td>
</tr>
<tr>
<td>Escondida</td>
<td>Chile</td>
<td>1990</td>
<td>Mitsubishi Co, IX Nippon Mining &amp; Metal, Mitsubishi Material</td>
<td>12.5%</td>
</tr>
<tr>
<td>Candelaria</td>
<td>Chile</td>
<td>1995</td>
<td>Sumitomo Metal Mining, Sumitomo Corporation</td>
<td>20%</td>
</tr>
<tr>
<td>Northparkes</td>
<td>Australia</td>
<td>1996</td>
<td>Sumitomo Metal Mining, Sumitomo Corporation</td>
<td>20%</td>
</tr>
<tr>
<td>Huckleberry</td>
<td>Canada</td>
<td>1997</td>
<td>Mitsubishi Material, Dowa Furukawa, Marubeni Co</td>
<td>50%</td>
</tr>
<tr>
<td>Collahuasi</td>
<td>Chile</td>
<td>1999</td>
<td>Pan Pacific Copper (PPC), Mitsui Co</td>
<td>12%</td>
</tr>
<tr>
<td>Batu Hijau</td>
<td>Indonesia</td>
<td>1999</td>
<td>Sumitomo Co, Sumitomo Metal Mining, Mitsubishi Material, Furukawa</td>
<td>24.5%</td>
</tr>
</tbody>
</table>

- Investment ratios of Japanese companies have been increasing.
- Japanese companies own an operatorship in some overseas mines.

### Investment of Japanese Mining & Smelting Companies in Copper Mines (2000~)

<table>
<thead>
<tr>
<th>Copper mine</th>
<th>Country</th>
<th>Start Operation</th>
<th>Japanese companies</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Pelambres</td>
<td>Chile</td>
<td>2000</td>
<td>PPC, Mitsubishi Material, Marubeni Co, Mitsubishi Co</td>
<td>40%</td>
</tr>
<tr>
<td>Atakama Kozan</td>
<td>Chile</td>
<td>2003</td>
<td>Nittetsu Mining</td>
<td>60%</td>
</tr>
<tr>
<td>Cerro Verde</td>
<td>Peru</td>
<td>2006</td>
<td>Sumitomo Metal Mining, Sumitomo Co</td>
<td>21%</td>
</tr>
<tr>
<td>Ojos</td>
<td>Chile</td>
<td>2006</td>
<td>Sumitomo Metal Mining, Sumitomo Co</td>
<td>20%</td>
</tr>
<tr>
<td>Copper Mountain</td>
<td>Canada</td>
<td>2011</td>
<td>Mitsubishi Material</td>
<td>25%</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>Canada</td>
<td>2013</td>
<td>Dowa, Furukawa, Sojitz</td>
<td>25%</td>
</tr>
<tr>
<td>Caserones</td>
<td>Chile</td>
<td>2013</td>
<td>PPC, Mitsui Co</td>
<td>100%</td>
</tr>
<tr>
<td>Sierra Gorda</td>
<td>Chile</td>
<td>2014</td>
<td>Sumitomo Metal Mining, Sumitomo Co</td>
<td>45%</td>
</tr>
<tr>
<td>Morenci</td>
<td>USA</td>
<td>1987</td>
<td>Sumitomo Metal Mining (13% added)</td>
<td>25%</td>
</tr>
</tbody>
</table>
Global Mine Development by Japanese Companies

Japanese companies have been investing overseas nickel mines to secure stable supply of nickel ore.

<table>
<thead>
<tr>
<th>Mine</th>
<th>Country</th>
<th>Type of deposit</th>
<th>Company</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorowako</td>
<td>Indonesia</td>
<td>Laterite ore</td>
<td>Sumitomo Metal Mining Sumitomo Co</td>
<td>20%</td>
</tr>
<tr>
<td>Rio Tuba</td>
<td>Philippines</td>
<td>Nickel oxide</td>
<td>Pacific Metals, Sojitz NAC※</td>
<td>56%</td>
</tr>
<tr>
<td>Taganito</td>
<td>Philippines</td>
<td>Nickel oxide</td>
<td>Pacific Metals, Sojitz NAC</td>
<td>52%</td>
</tr>
<tr>
<td>Figesbal</td>
<td>New Caledonia</td>
<td>Laterite ore</td>
<td>Sumitomo Metal Mining</td>
<td>25.5%</td>
</tr>
<tr>
<td>SNL</td>
<td>New Caledonia</td>
<td>Laterite ore</td>
<td>Nisshin Steel</td>
<td>10%</td>
</tr>
</tbody>
</table>

(注) NAC (Nickel Asia Corporation) : Sumitomo Metal Mining invested 26%

Nickel Production by HPAL

Successful commercial operation of the HPAL (High Pressure Acid Leach) plant in the Philippines by Sumitomo Metal Mining enabled the treating of low grade nickel ore to produce mixed sulfide.

The success of the HPAL technology on a commercial scale is the first of its kind in the world.

- The HPAL plant of Coral Bay Nickel succeeded on a commercial scale in 2005 for the first time in the world.
- The mixed sulfide produced by the HPAL is shipped to Sumitomo Metal Mining’s Niihama Refinery in Japan where it is treated to produce electrolytic nickel and cobalt.
- Subsequently in 2009, Taganito project, also in the Philippines, was successfully launched to secure SMM's 60,000 ton per annum production.
Outlook of Japanese Copper Markets

- The demand for refined copper in Japan is 972kt in 2016, the situation has remained flat or slightly declining in recent years.

- Regarding future prospects, there are plus materials such as electric wire underground landing, updating of aged electric power equipment, infrastructure improvement of the Tokyo Olympic Games, etc. for the electric wire of the largest demand field.

- While copper demand for automobiles is expected to increase due to the EV shift in the automobile industry, on the other hand, due to overseas shifts in the automobile industry and a decline in domestic production due to population declines, this will offset the increase in demand by EV shift.

- As for the copper and copper brass industry, domestic demand has been declining and this trend will continue in the future.

- From the above, it is expected that demand for refined copper in Japan will slightly increase or remain flat over the medium term.
Outlook of Japanese Nickel Markets

- Japan’s demand for the primary nickel was 142kt in 2015. It has been increasing slightly in recent years.
- The nickel demand is heavily influenced by production of stainless steel / special steel which accounts for 60 to 70% of nickel demand. The trend of production of stainless steel / special steel in recent years has been almost flat, and no significant growth is expected in the future.
- As a positive factor of demand for nickel, EV shift of the automobile industry, and there is already signs of an increase in demand for nickel for lithium ion batteries. Demand is expected to further increase due to acceleration of EV shift.
- As a result of the above, further increase in demand for nickel in the future is expected from a slight increase till now.

Outlook of Japanese Zinc Markets

- The demand of refined zinc in Japan has decreased year by year from 600kt in early 2000’s to 470kt in 2016. Outlook of refined zinc demand in Japan will remain in the similar declining trend.
- It is expected slightly demand increase by infrastructure development for the Tokyo Olympic Games in 2020, but it will be temporary increase in zinc demand and it cannot recover the total Japan’s zinc demand.
- The view that domestic production of automobiles will decline towards 2030 is strong, and zinc demand for plated steel sheets is expected to remain on a downward trend.
- Overall, the current domestic demand of 470kt is expected to decline to about 400 ~ 450kt through 2030 (forecast by MERIJ).
Outlook of Japanese Lead Markets

- Demand for refined lead in Japan was 260kt in 2016. 90% of domestic lead demand is for storage batteries. The lead demand is greatly affected by the number of vehicles produced.
- If 9.2 million current car production in Japan will decline to 8 million units around 2025, the lead demand for storage batteries is expected to decrease from the current 230kt to the 190kt level.
- Overall, the domestic demand of 260kt at present will decrease from 220 to 230kt in 2025 (forecast by MERIJ).
- In addition, due to the future EV shift of automobile production in Japan, there is also the possibility that the decrease in the lead demand for lead storage batteries may be further accelerated.

Conclusion

- Japanese Nonferrous Metal Industries shall continue to play important roles as stable suppliers of high quality materials and products.
- Japanese market for Nonferrous Metals is expected to be robust, thanks to the demands from auto and other industries.
- It is necessary for the smelting industry to contribute in establishing a Sound Material-Cycle Society by recycling and recovering rare-metals on top of stable production of the base metals.
- As environmental regulations having been strengthened, smelting industry shall continue to pursue all possible measures for environmental issues.
- The rise of resource nationalism is one of the major risk factors for Japan, poor in natural resources. It is important for both resource-rich and import countries to establish a relationship of trust.
- It is important to further enhance the competitiveness and also important to secure and cultivate human resources who should play a significant role in the future development of the industry.
- It is important for the resources/smelting industry to achieve sustainable development based on these efforts.
Outline of Metal Economics Research Institute, Japan MERI/J

**Principle Aim**
Promote Economic Research on Variety of Issues related to Nonferrous Metal Industries and Markets

**Subjects**
- Base Metals
- Rare Metals
- Critical Metals
- Supply & Demand
- Risk Analysis
- World Economy
- Metal Industries
- Recycle
- Innovation
- Substitute

**Scope of Work**
- Research Themes Matched with Industrial Needs
- Comprehensive Research & Analysis
- Dissemination of Information & Recommendations
- Active Exchanges with Various Institutes

**[Research Themes in 2017]**
- Problem and Technical Countermeasures for Impurities in Copper Smelting in Japan
- Current Status and Outlook for Zinc Smelters in China
- Recycle of Nonferrous Metals in China
- EV and Metals (resources and supply & demand forecast of Li, Co, Ni and other metals)
- Current Status and Outlook for E-scrap Recycle in Japan
- Renewal of Power Cables in the Japanese Infrastructure
- Situation and Perspective of International Metal Markets

- Seminar on 2016 results in Tokyo (4, July 2016) & Osaka (19, July 2016)
- Lectures delivered to individual companies
- Seminar on Chinese Copper Industry (November, 2017)
- Lectures in Domestic & Overseas Seminar
- Interchange with Internal & External Institutes

Thank you very much for your attention!