

Greeting



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Prof. Univ. Hyogo

A leading domestic industrial cluster related to metallic materials and metal processing has been formed on the coast of the Seto Inland Sea in Hyogo Prefecture. We have named this area "Hyogo Metal Belt" and aim to revitalize it further. University of Hyogo established "Research Center for Advanced Metallic Materials" on the Himeji Engineering Campus in April 2019 with support from the Cabinet Office and Hyogo Prefecture for a regional revitalization project. With the primary aim of supporting local companies, the center was established as the Himeji satellite of Hyogo Prefectural Institute of Technology and is run by University of Hyogo.

The present research center features two "3D printers for metals". An electron beam and a laser beam type were equipped by focusing on the subjects that are currently attracting attention worldwide. The electron beam type makes it possible to produce 3D metallic objects even for metal powders with high activity and melting points, such as Ti-based alloy. On the other hand, the laser beam type can perform 3D printing even in the atmosphere.

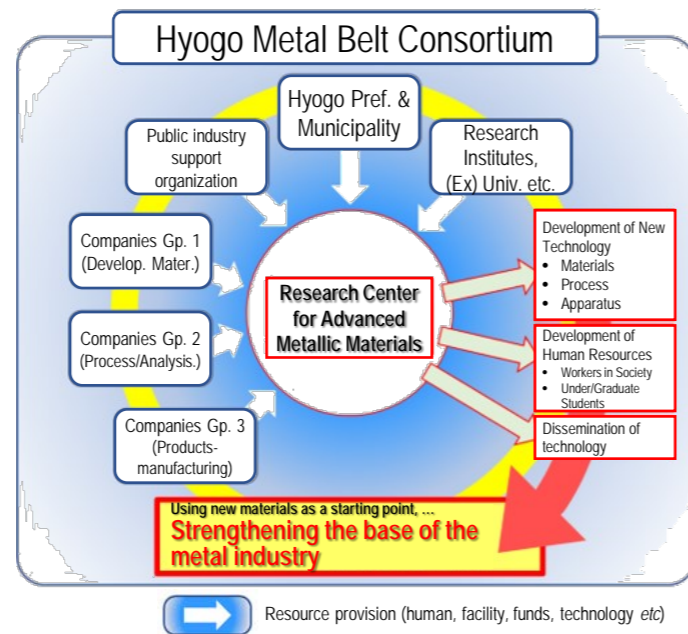
Additive manufacturing (AM) technology enables us to produce complex structures that are impossible through conventional casting and cutting technology. Hence, AM is expected to be an epoch-making metal-forming technology for the next generation.

In addition, the present center provides other apparatuses that are necessary for developing new metal materials, such as arc melting and high-frequency induction furnaces, gas atomization apparatus, electron beam microanalyzer, etc. Furthermore, the present center organized "Hyogo Metal Belt Consortium" to promote the improvement and spread of technology in the region.

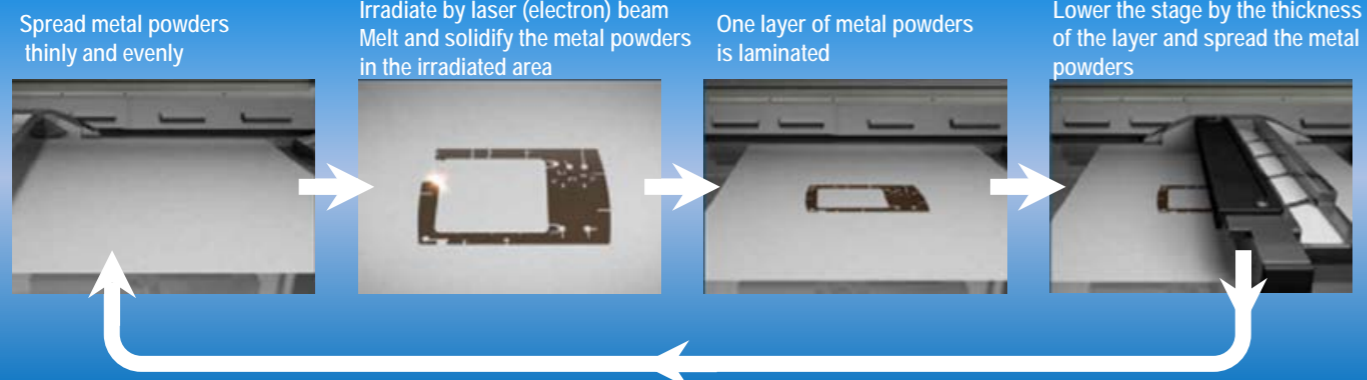
The present center has continued its activity under Prof. Toru YAMASAKI's direction since its establishment. I (Akira TAKEUCHI), herewith, was appointed as the head of the present center in April 2022 as his successor. We would like to express our gratitude for the support we have received thus far and ask for your continued support and guidance.

Facilities and overview of activities

- Established as the Himeji satellite of Hyogo Prefectural Institute of Technology
- The base of Hyogo Metal Belt Consortium
- Advanced research using a 3D metallic printer of electron beam type
- Support for small and medium-sized enterprises (SMEs) using a 3D metallic printer of laser beam type
- Research new materials by making the most of Hyogo's strong points
- Development of advanced materials and devices for medical application
- Usage of apparatuses mainly not for actual manufacturing but for technical development through trial and error
- Promoting the usage of apparatuses by SMEs via financial support to only accrue actual (material) costs



Mechanism of AM (powder bed type metal 3D printer)



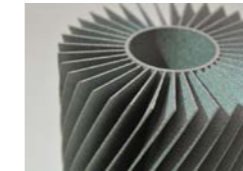
Provided by: Matsuura Machinery Corporation

Overview of facilities

- Metal 3D printer (Electron beam type): Aiming for the world's most premiers with companies in Hyogo prefecture
- For metals with high melting points and high thermal conductivity, such as nickel, titanium, and copper
 - Research and development of advanced medical devices, such as artificial joints made of titanium



3D printer body
Modeling example: Fin Ti-6Al-4V



Product based on TRAFAM Elemental Technology Research and developed(*) by Tada Electric Co., Ltd.

- Setting up arbitrarily molding conditions available
- Variable output of electron beam up to 6 kW
- Prevention of deterioration due to oxidation and nitriding
- Reduced residual stress and cracks
- Maximum modeling size: W250 x L250 x H350 (mm)

TRAFAM: Technology Research Association for Future Additive Manufacturing
(*) This research machine utilizes the results of a subsidized project provided by New Energy and Industrial Technology Development Organization (NEDO).

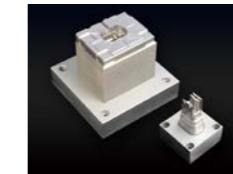
- Metal 3D printer (Laser beam type): Aiming to spread 3D modeling technology to SMEs

- Hybrid type combining "AM" and "machining"
- For molding of cobalt chrome and aluminum, in addition to maraging and stainless steels



3D printer body

Modeling example:
resin mold
maraging steel



Product of Matsuura Machinery Corporation
LUMEX Avance-25

- One machine-one process, repeating lamination and high-speed/high-precision end mill cutting
- Three-dimensional cooling channels and deep rib processing are possible
- Cutting of back taper
- High power 500W Yb fiber laser
- Maximum modeling size: W256 x L256 x H300 (mm)

- Apparatuses for manufacturing alloys & powders and those for measuring the size distribution of powder particles

- High-frequency induction furnace: Alloy preparation by melting samples via high-frequency induction heating and casting
- Arc melting furnace: Sample preparation by DC arc discharge heating, mainly for alloys with high-melting temperature
- Gas atomizer: Production of powders by applying high-pressure gas sprayed on molten alloy
- Particle size distribution (PSD) measuring device: Measures the PSDs of powder from laser diffraction and scattering



Products of Nisshin Giken Co., Ltd.
No. 1 High freq. induc. furnace
NEV-M1T type
No. 2 Arc melting furnace
NEV-ADR1 type
No. 3 Gas atomizer
NEV-GA1T type

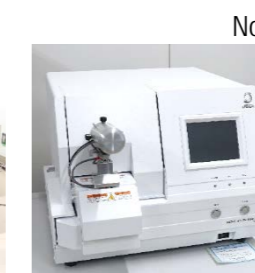
Product of MicrotracBEL Corporation
No. 4 Laser diffraction/scattering type
PSD analyzer MT3000 II SERIES

Analyzers

- Field emission type electron probe microanalyzer: Observation at micrometer-scale areas of materials and analysis of surface and composition



No. 1



No. 2

JEOL
No. 1 FE-EPMA
JXA-8530FPlus
No. 2 Cross-Section Polisher
IB-19530CP

Observation samples can be cut out with high precision

<Cover page>

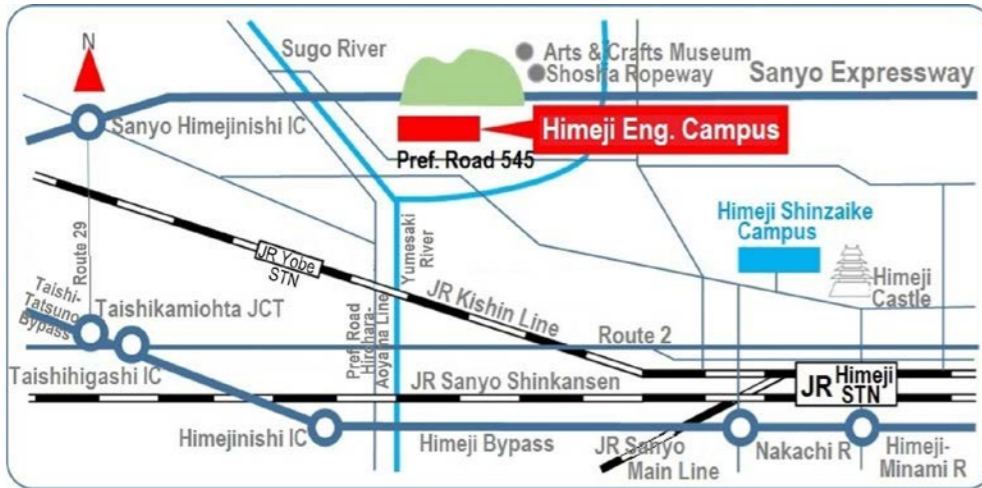
Top: Highly functional spherical metal powders (left) and cross-section of powder particles (right) produced by gas atomization [Provided by Sanyo Special Steel Co., Ltd.]

Middle (left): A demonstrated example of a mold using hybrid processing of machining with laser beam 3D modeling [Provided by Matsuura Machinery Corporation]

Middle (right): An example of modeling without support using an electron beam 3D modeling [Provided by Tada Electric Co., Ltd.]

Bottom: Ni-based metallic glass powders (left), laminated objects (middle), and mother alloy & cast bar (right) [Provided by Institute for Materials Research, Tohoku Univ.]

<Access Map to Himeji Engineering Campus, University of Hyogo >

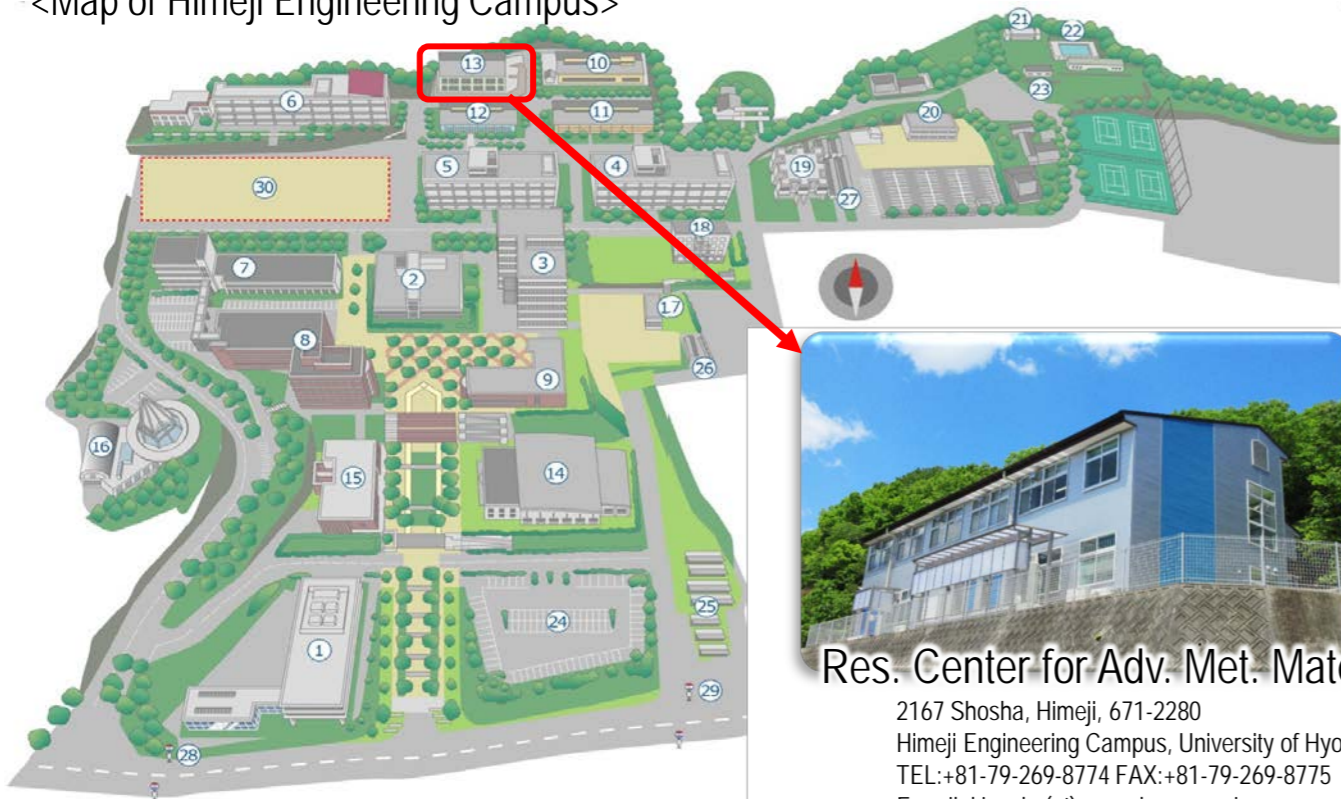


Get off at Himeji Station (JR or Sanyo Electric Railway)
Get on a Shinku bus and get off at "Kenritsu Dai Kougakubu"

Busses with destination Nos. 41-45 from Shinku Bus Terminal Platform No. 18 (North Exit of JR Himeji Station)

The buses for either Kenritudai-Kougakubu, Shosha West Housing, Midoridai, Burdstown, Yamazaki, Araki, or Kosebata (about 25 minutes on the bus)

<Map of Himeji Engineering Campus>

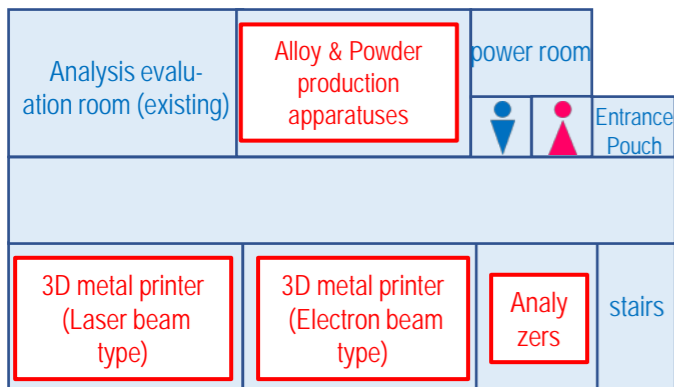


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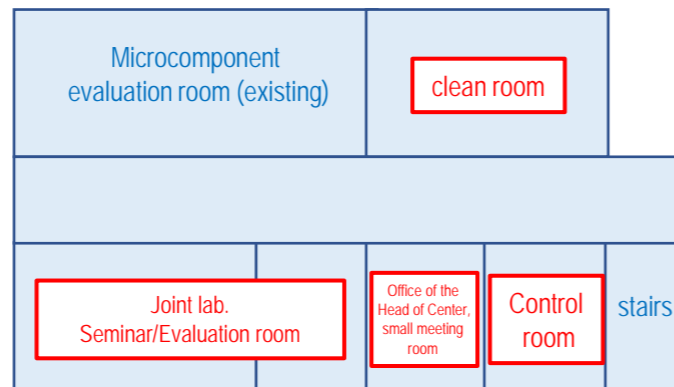
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Note: Please replace "(at)" with "@" when sending email.

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【Corresponding address】

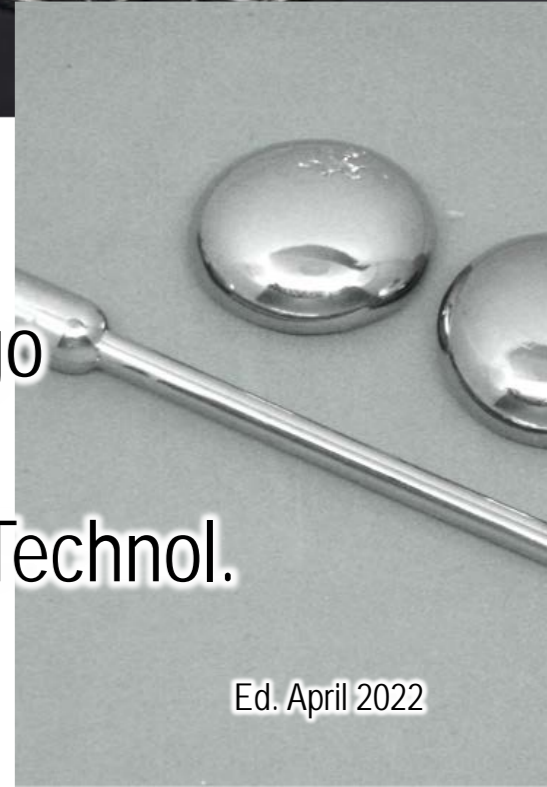
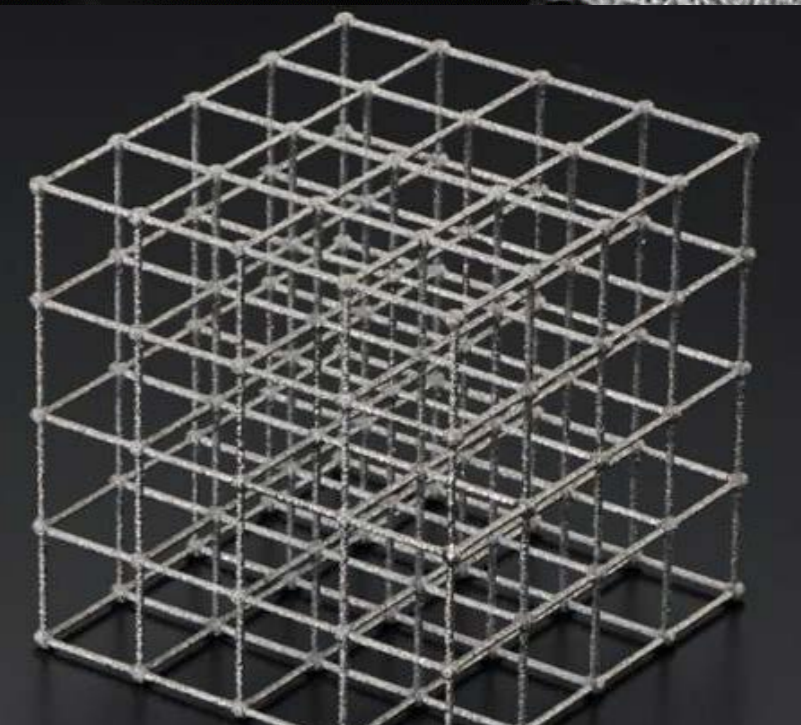
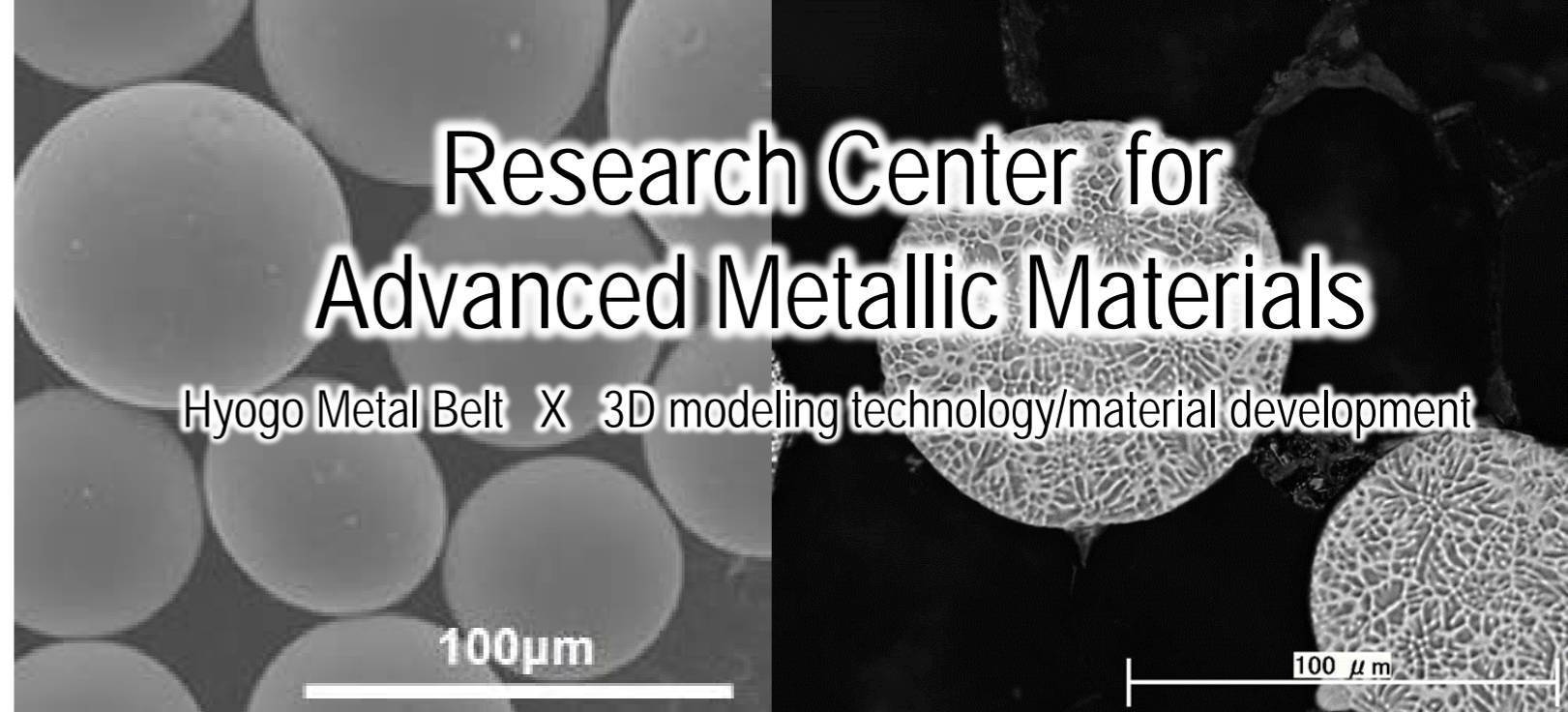
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Webpages (in Japanese)

<https://www.u-hyogo.ac.jp/research/center/kinzoku.html>
Research Center for Advanced Metallic Materials
<https://www.u-hyogo.ac.jp/research/center/metalbelt.html>
Hyogo metal belt consortium

Research Center for Advanced Metallic Materials

Hyogo Metal Belt X 3D modeling technology/material development



University of Hyogo

Hyogo Pref. Inst. Technol.