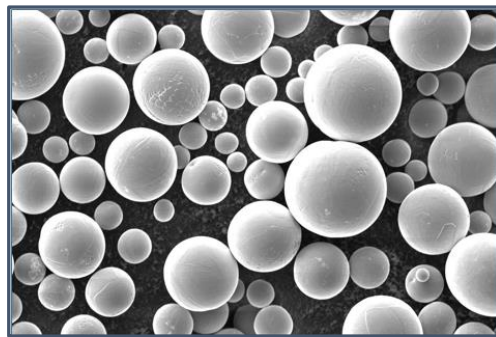




PREP powder, better for Metal AM
～デジタルものづくり・金属積層工法に理想的な原料粉末（PREP粉末）～



2nd German-Japanese Digitalization-Dialogue

Additive Manufacturing Forum

2nd July, 2019

Corporate Profile

■Name	JAMPT Corporation *Japan Additive Manufacturing & Processing Technology
■Established	October 18, 2017
■Capital	JPY 955 million (Capital:482million, Capital Reserve:472million) / Approx. US \$ 8.6million
■Shareholder	Sojitz (56%), Koiwai (34%), Tohoku University (10%)
■CEO	Noritaka Yasuda (from Sojitz)
■Location	3-8,Ipponyanagi,Tagajo-shi,985-0874,Miyagi-ken,Japan
■Business	Total Solution Provider for Metal AM (3D printing)
■URL	https://www.jampt.jp/en/



Miyagi Factory (HQ)

Start operation : Aug 10, 2018



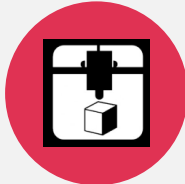


Contact Information:

E-Mail: komatsu.nobuhiro-2@sojitz.com

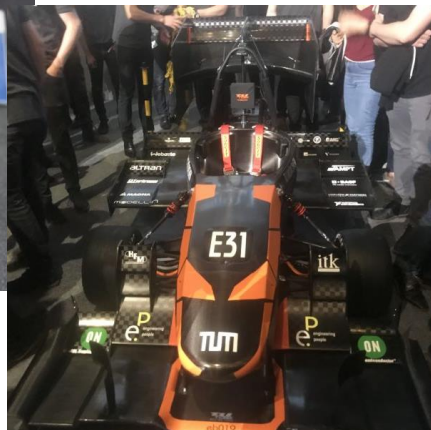
Tel : +81-80-8733-4811

E-Mail: takahashi.mitsuya@jampt.jp

Tel : +81-22-290-0630

Category			
	Additive Manufacturing	Material Powder	Printer Development
Services	<ul style="list-style-type: none"> • Prototyping • Commercial Production • Design Optimization (future) • Post Processing (future) 	<ul style="list-style-type: none"> • PREP powder development, production & marketing • Development of Metal Powder / New Materials with Tohoku Univ. 	<ul style="list-style-type: none"> • In close collaboration with Japanese AM Machine manufacturer

- ✓ Sponsoring TUFast Racing Team, TU Munich, and supply AM parts (Housing)



- ✓ Joined Mobility goes Additive (MgA), the leading international AM industrial network

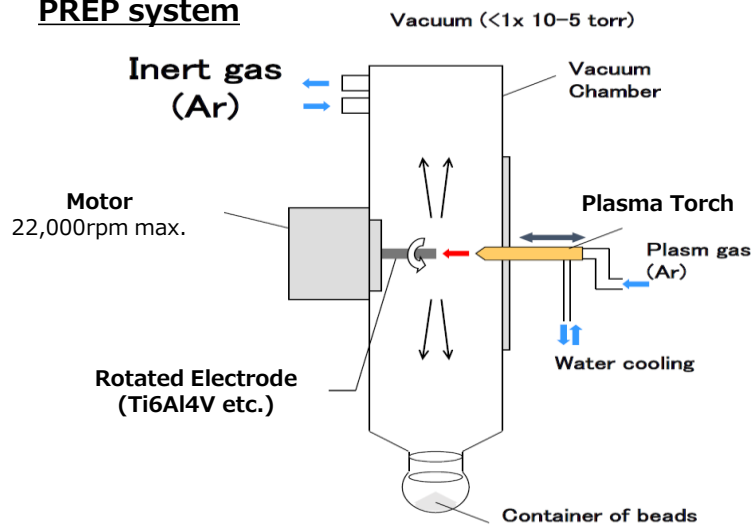


JAMPT – PREP powder for AM

What is PREP?

- ✓ PREP is one of the most advanced technologies for metal powder production and is suitable for additive manufacturing due to its characteristics of high-sphericity, no gas contents, no satellites, no contamination.
- ✓ PREP powders have a very high internal density because the molten metal is pulled off the bar surface by centripetal acceleration so there is no entrapped gas in particles.
- ✓ JAMPT's PREP production is supervised by Prof. Akihiko Chiba of Tohoku University, Japan's most known university/laboratory for metallurgy.
- ✓ JAMPT' PREP machine rotates 300mm x 70mm electrode at 20,000rpm, gives particle size of 30-100 μ .

PREP system



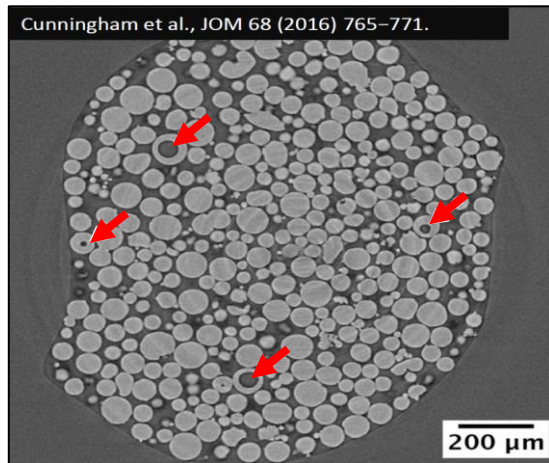
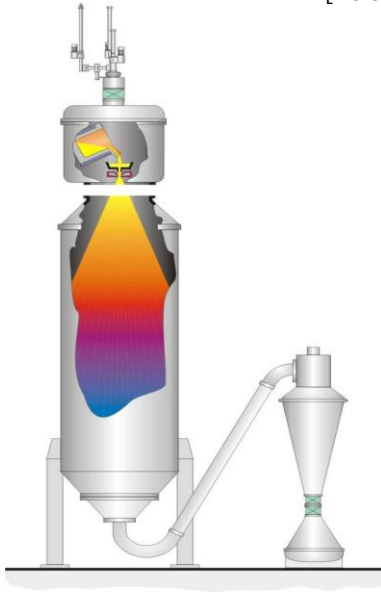
PREP equipment in JAMPT@Miyagi



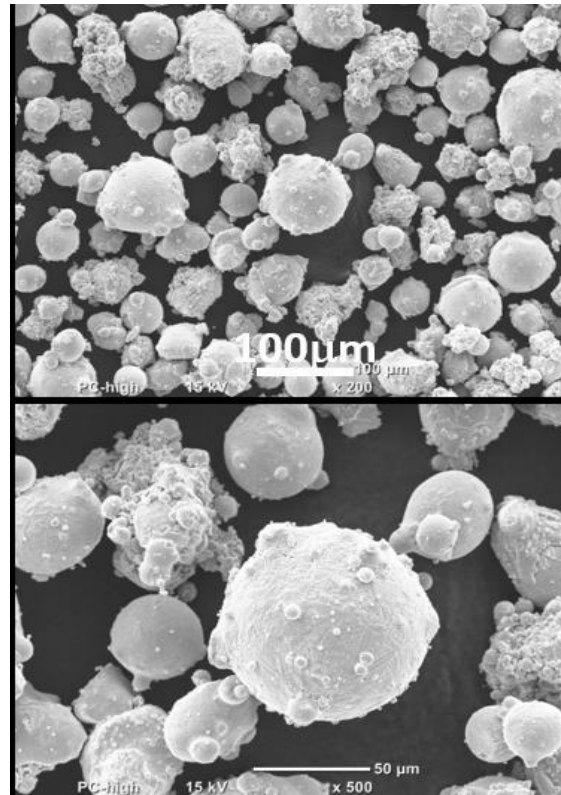
Technical issue in using existing powder for AM (1)

Gas atomization (VIGA, EIGA)

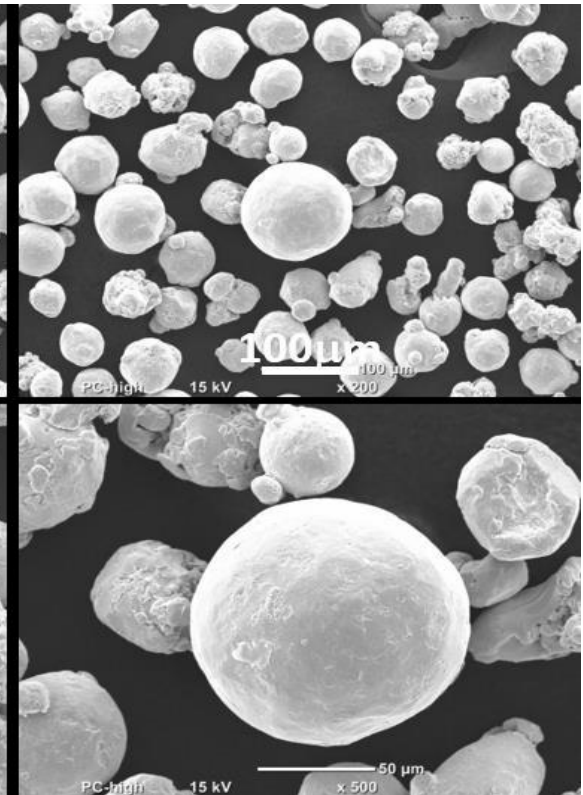
[Reference] AP&C



As production



After Jet-milling

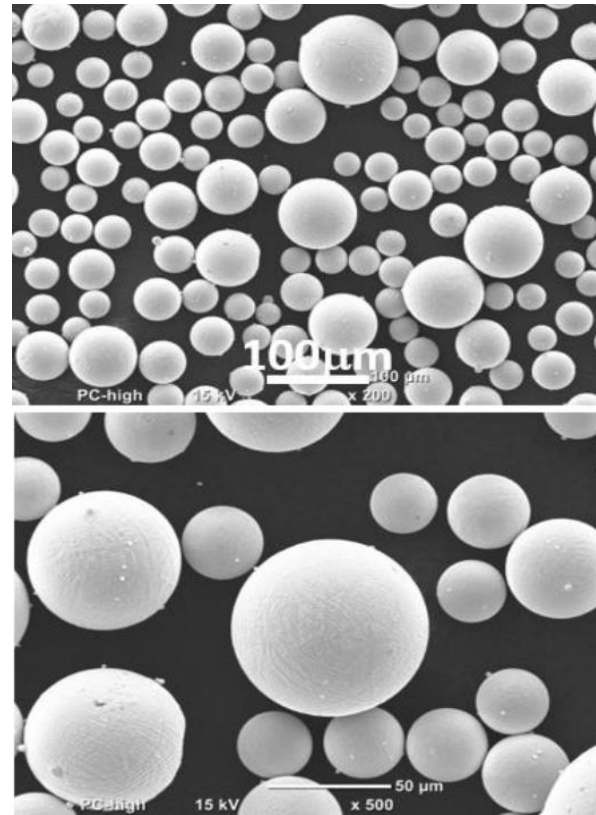
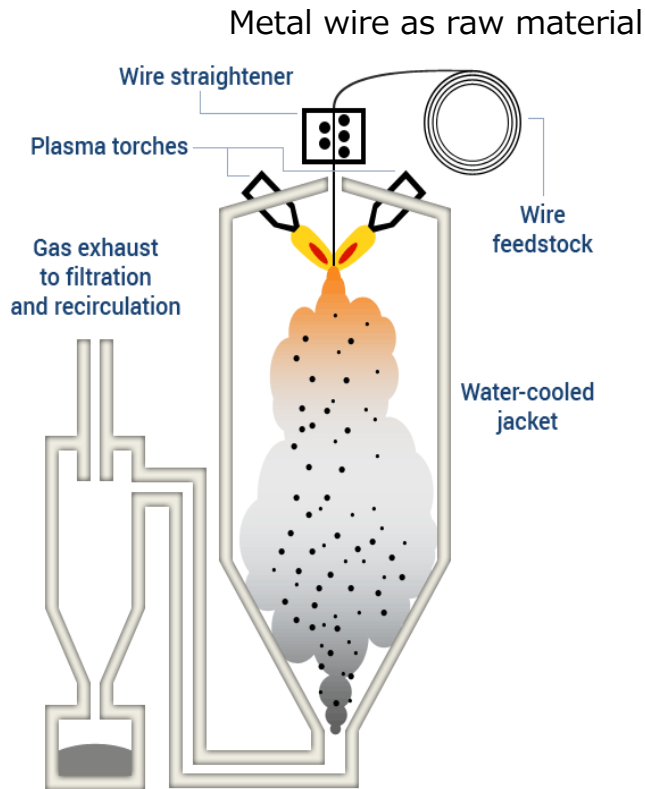


- ✓ Gas Atomized powder tend to have **low sphericity**, **much satellite** and **gas porosity**.
- ✓ Gas inclusion is inevitable due to its production process.

Technical issue in using existing powder for AM (2)

Prasma atomization

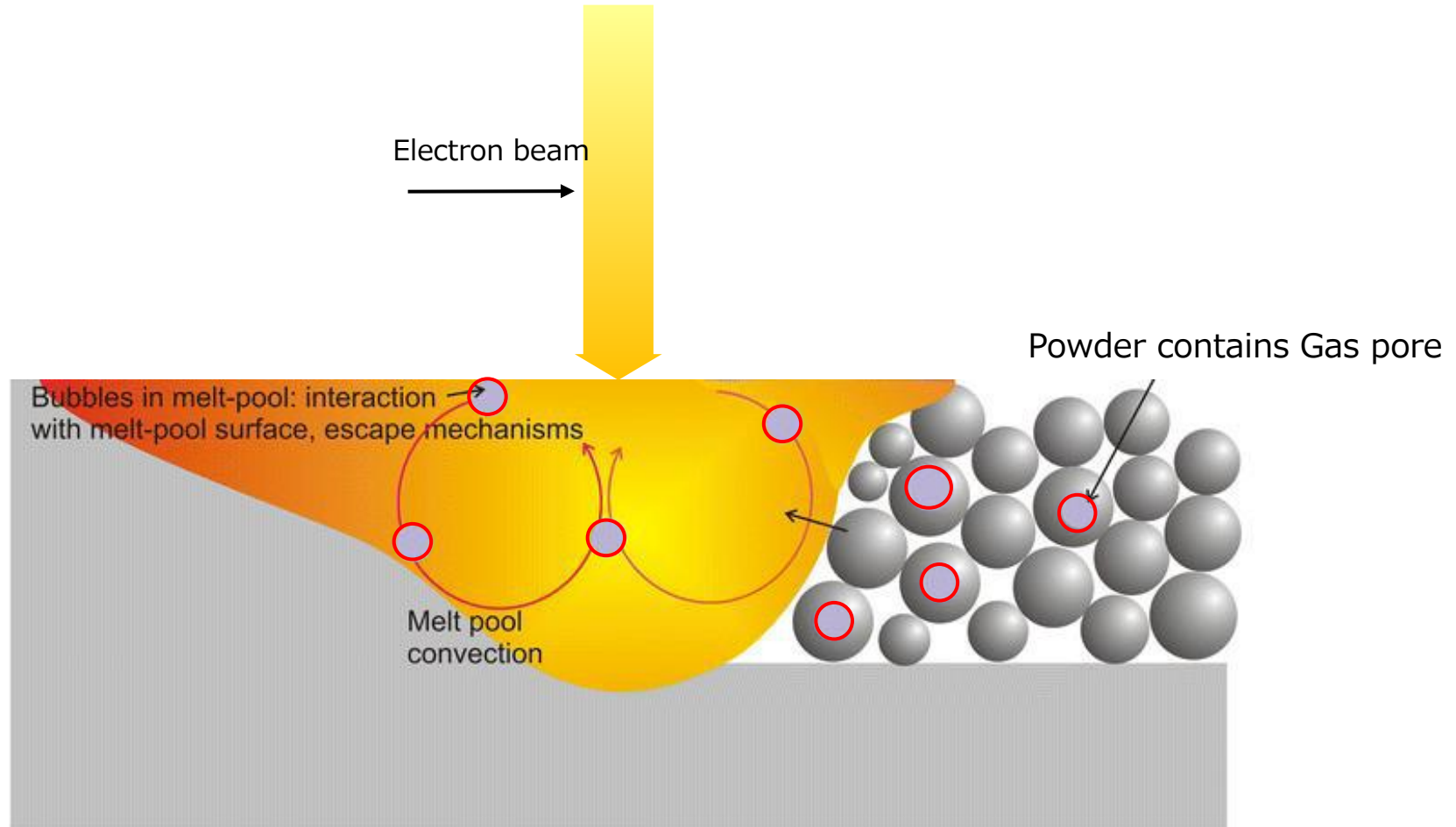
[Reference] AP&C



- ✓ Plasma-atomized powder is superior in quality (Sphericity and less Satellite) than Gas-atomized powder but **still contains a certain amount of gas porosity**.
- ✓ It's also inevitable due to its production process.

Technical issue in using existing powder for AM (3)

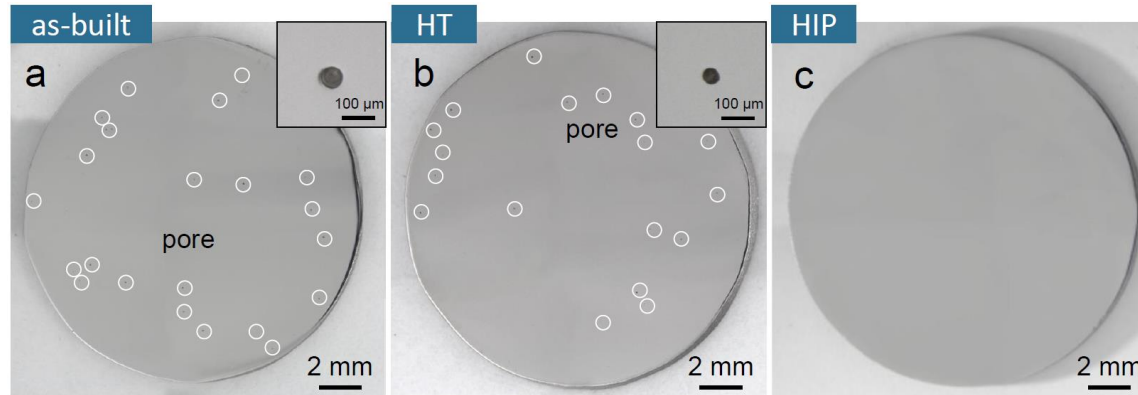
Mechanism of gas pore remains in AM process



- ✓ Gas porosities contained in material powder doesn't disappear but transfers to the components during the AM process.

Technical issue in using existing powder for AM (4)

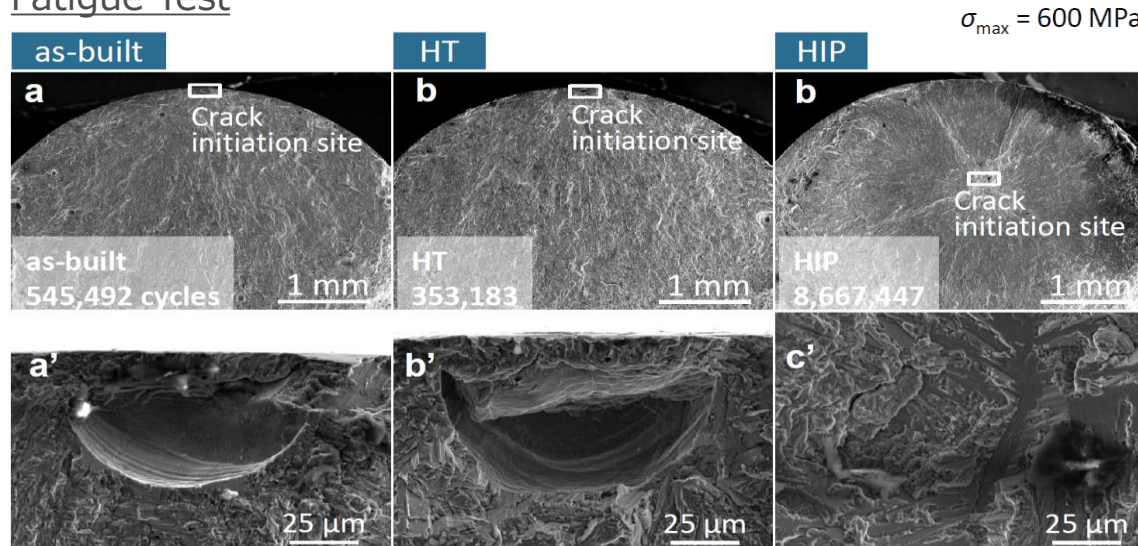
Comparison of gas porosities at AM sample (EBM / Ti6Al4V)



[Reference] Prof. Akihiko Chiba / Chiba Laboratory of Deformation Processing, Institute for Materials Research, Tohoku University

- ✓ Many gas porosities are observed in "As-built" and "Heat Treated(HT)"
- ✓ No gas porosity is observed after "HIP"
- ✓ Gas porosities come from powder

Fatigue Test

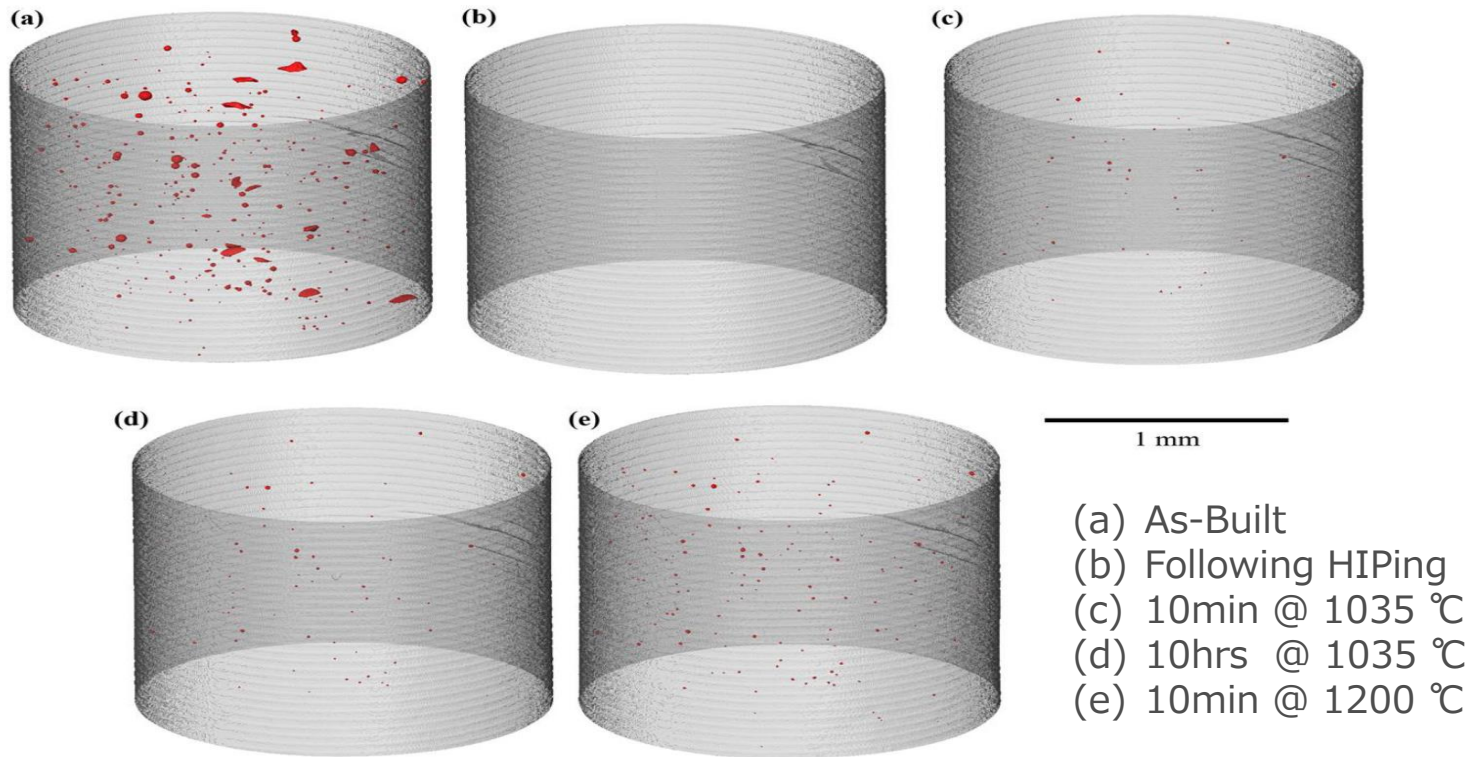


- ✓ During fatigue test, crack initiation occurred from surface for "As-built" and "HT"
- ✓ Crack initiation occurred from internal for "HIP"
- ✓ "HIP" material broke at 8.7M cycles at 600MPa.

[Reference] Prof. Akihiko Chiba / Chiba Laboratory of Deformation Processing, Institute for Materials Research, Tohoku University

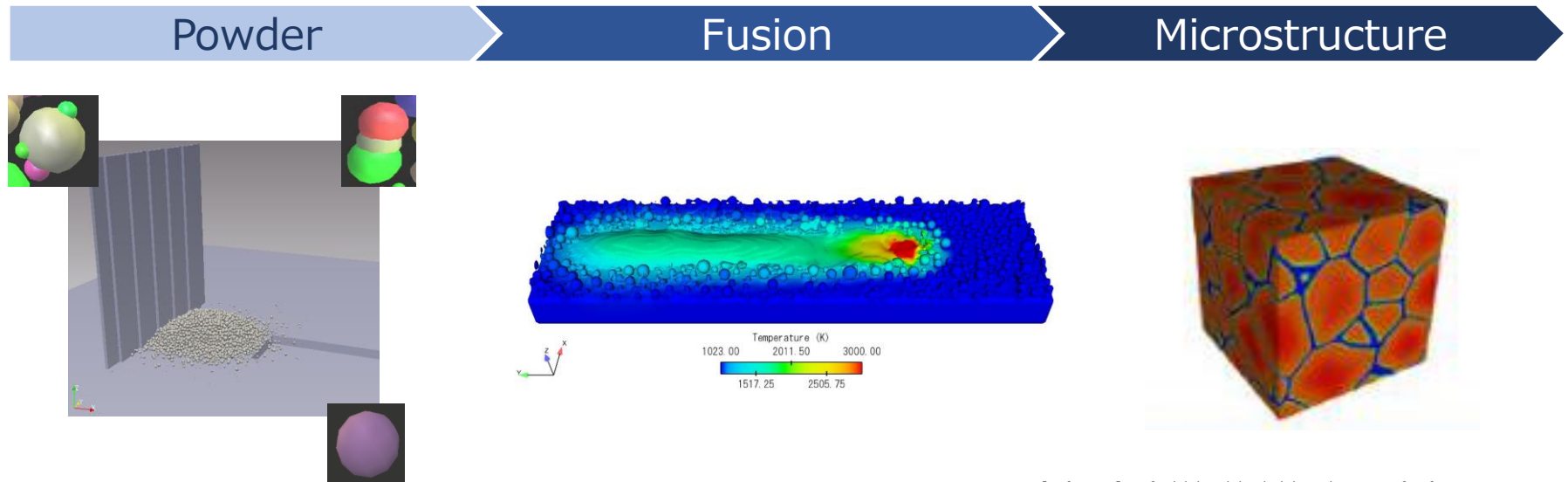
Technical issue in using existing powder for AM (5)

Visualization of the porosity (in Red) imaged by CT scans of the same cylindrical sample.



- ✓ Porosity disappears after HIP, but does regrowth under the condition of high temperature.
- ✓ HIP is costly and not a perfect solution especially for the application where high fatigue strength is required.

CPS requires ideally spherical powder, PREP could be



[Reference] Prof. Akihiko Chiba / Chiba Laboratory of Deformation Processing, Institute for Materials Research, Tohoku University

Parameter for AM process simulation

【Powder bed】

- Powder properties
- Layer thickness
- Bulk density
- etc.

【Hydrodynamics】

- Convection
- Evaporation
- Heat transfer
- Mass transfer
- etc.

【Solidification】

- Temperature gradient
- Solidification speed
- etc.

Spherical powder

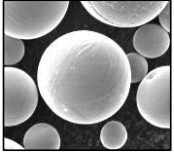
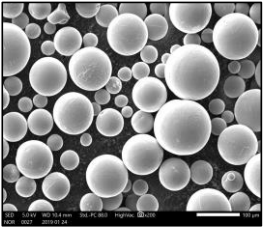
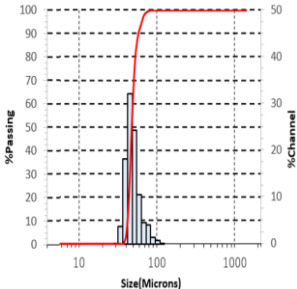
Process simulation for AM

Establish CPS

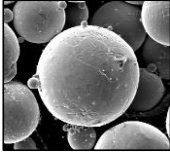
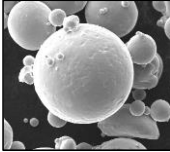
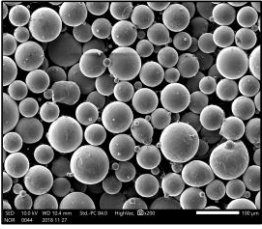
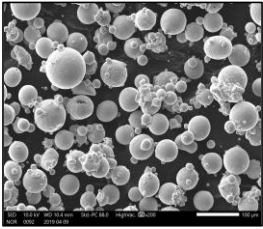
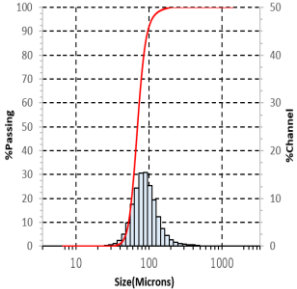
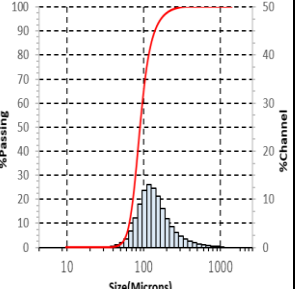
※ CPS : Cyber Physical System

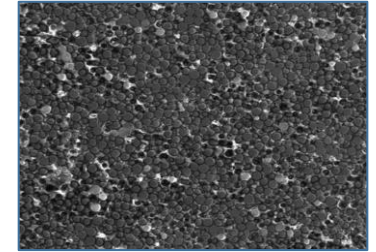
JAMPT's PREP powder (1)

Comparison with other powders

	JAMPT's PREP powder
Sphericity	Excellent
Gas Porosity	Zero
Satellite	Very Limited
Flowability	High
Powder Image (1)	
Powder Image (2)	
Size Distribution	

vs.

Plasma Atomized (in general)	Gas Atomized (in general)
Good	Good
Limited	More
Some	More
Medium	Less
	
	
	



Sectional view (SEM)
of JAMPT's PREP
powder: No gas
porosity is can be
observed.

- ✓ JAMPT's PREP technology provides superior powder quality than other technology.
- ✓ Materials JAMPT offers by PREP is Ti6Al4V, Inconel 718, TiAl.

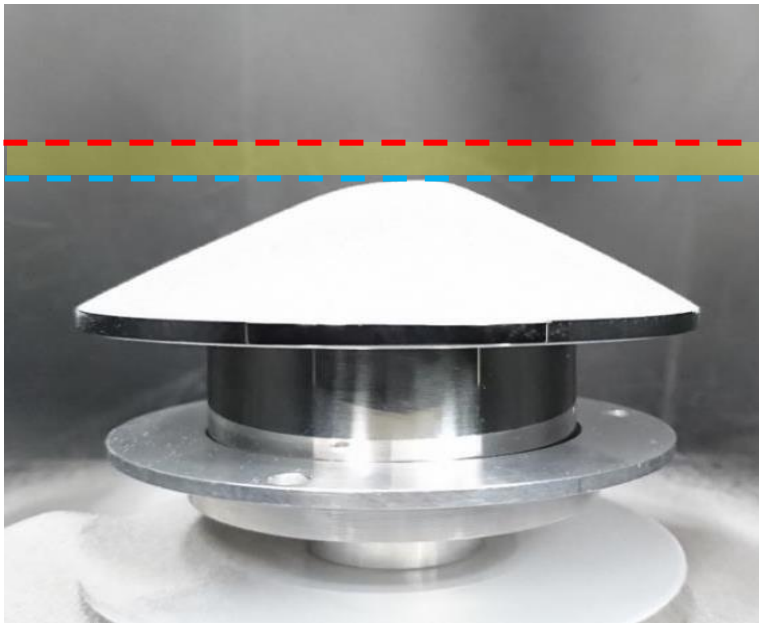
*Continuing to develop other materials

JAMPT's PREP powder (2)

- ✓ JAMPT's PREP powder is high in flowability which enables smooth spread of powder on build stage and more accurate production.
- ✓ High sphericity enables powder users more close-to-reality input to the simulation software, resulting more accurate / trustworthy simulation result.

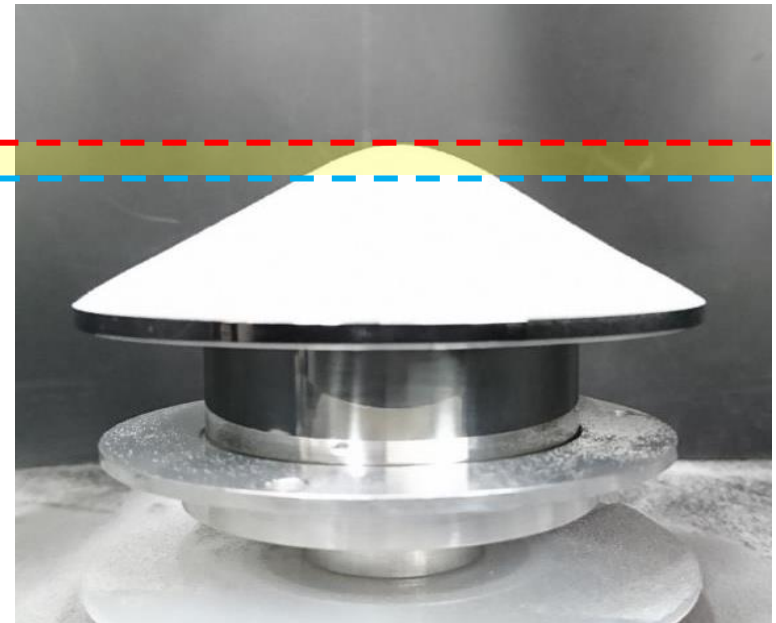
PAMPT's PREP Powder

Repose angle	28.4°
-----------------	-------



Gas Atomized Powder

Repose angle	34.3°
-----------------	-------



※ Repose angle : When dropping powder onto the stage, powder with high sphericity creates lower angle of repose.



Vielen Dank !!