Recent progress on Additive Manufacturing of Metals
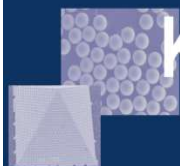
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3D printer

3D system Cube
c.a. $400〜2,000

・Expiring basic patents
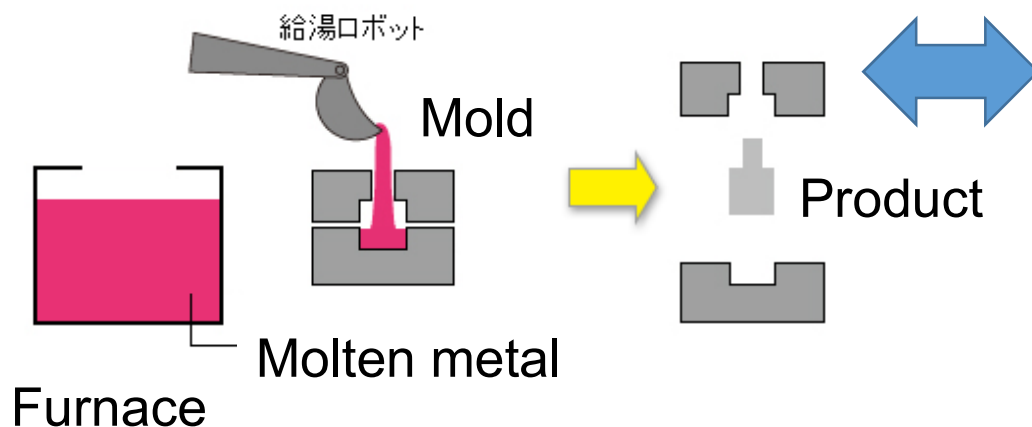・Commercially available
of polymer materials

1. Design

2. Print
automatically

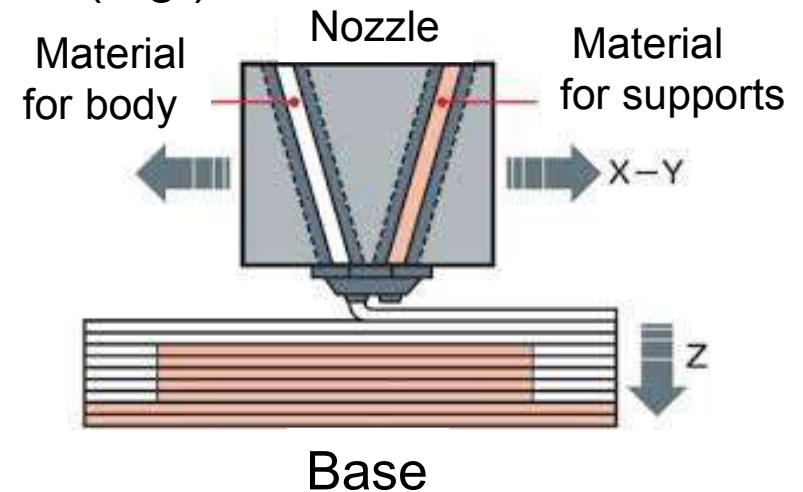3. Finish
net shape

"Manufacturing technology without mold"

Based on 3-D data, near-net shaped parts with complex shape can be fabricated by stacking paper, polymer, or powder.

Conventional casting

給湯ロボット

Mold

Product

Furnace

Molten metal

3D printing technology

(e.g.) Material extrusion

Nozzle

Material for body

Material for supports

X−Y

Z

Base

Introduction: What is 3D printing?

Machining

A Large bar is worked with cutting tools. Large amount of machined chips generates during cutting.

⬇

Subtractive Manufacturing

3D printing

www.dmgmori.com

Materials are stacked upward layer by layer and the products are built at the required area using minimum materials.

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"Additive Manufacturing"

Parameters for Powder Bed Fusion with Laser

1. Heat source
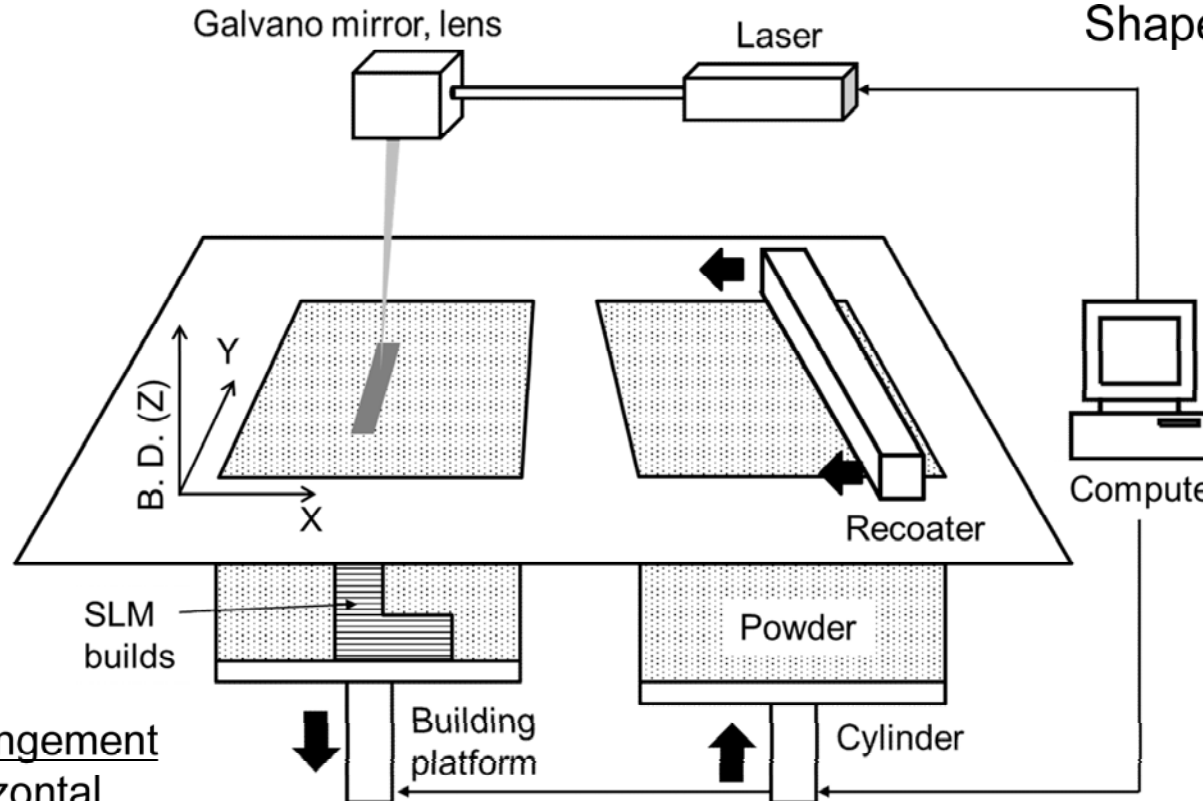Laser beam (CO_2, fiber laser etc.)
->wave length

Recoater
Shape, velocity

Atmosphere
Vac, Ar, N_2
Flow volume,
Fume, etc.

2. Energy density
Laser power
Scanning speed
Hatching distance
Layering thickness

Galvano mirror, lens

Laser

Y

B. D. (Z)

X

SLM builds

Computer

Recoater

Powder

Building platform

Cylinder

$$E = \frac{P}{v \cdot t \cdot h}$$

Specimen arrangement
Vertical or horizontal
Support, base plate
etc.,

Post processing
Hot isostatic pressing,
Solution heat treatment,
Aging

3. Powder
Shape, Diameter, Distribution,
Impurity, Flowability, Laser absorption

Summary: Future perspective

Important challenges for additive manufacturing

1. **Powder for additive manufacturing**

   Original powder for SLM or EBM should be developed to achieve better properties. Impurities from powder and/or process are unavoidable.

2. **New design**

   We have to pursue the structure which AM can only realize and conventional processing cannot fabricate should be considered.
   Such structure creates new products of high value. Functionally graded structure is challenging.

3. Parameters controlling
4. Approaching for improving productivity

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