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Case Hardening Properties of Additive Manufactured Steel

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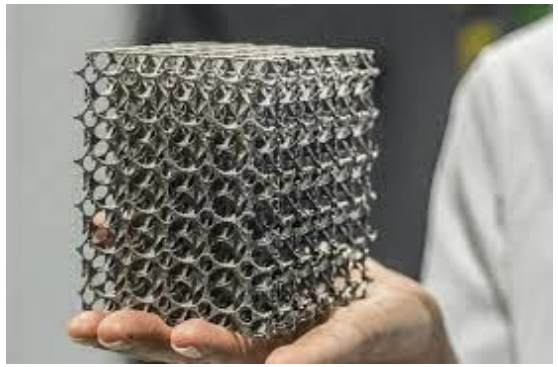
Background

Conventional carburizing heat treatment is expensive due to long processing time and large heat treatment deformation.



In recent years, metal 3D printer technology and product manufacturing have progressed.

Strength, precision and surface roughness are issues with metal 3D printer materials.

Purpose

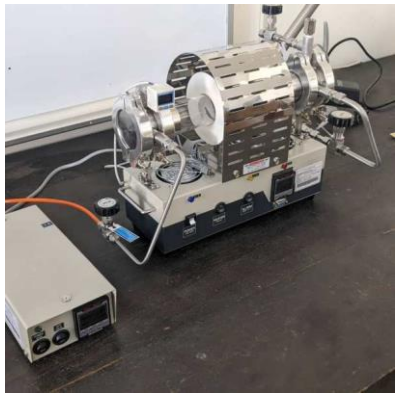
On carburizing and nitriding for metal 3D printer materials, to shorten carburizing treatment time and improve the toughness and strength of one.

Aiming to shorten heat treatment time by varying the metal crystal grain properties of metal 3D printer materials.

Method

Comparison of metals subjected to low pressure carburization (acetylene flow rate 50 [L/h]) for 2 hours.

This experiment: Maraging steel metal 3D printer material. The materials were made by NANKOU Laboratory by using Laser Melting Process



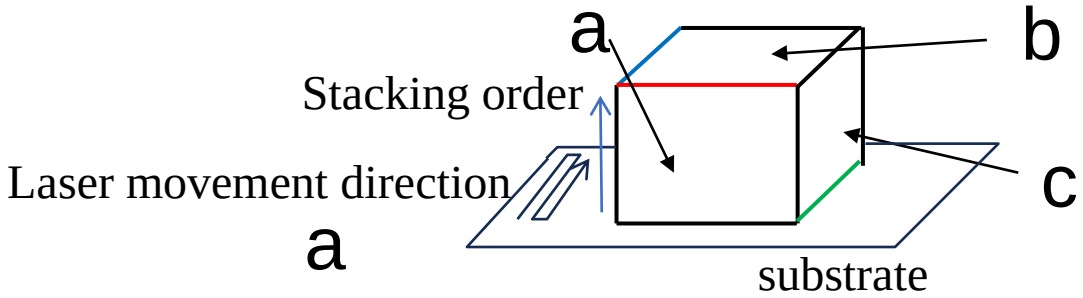
Tube Type Carburizing Furnace (ϕ60mm)

Test using optical microscope and Vickers tester.

Investigating the anisotropic properties of metal 3D printer materials.

Result

Showing the image and grain structure of metal 3D printer material obtained by optical microscope observation.



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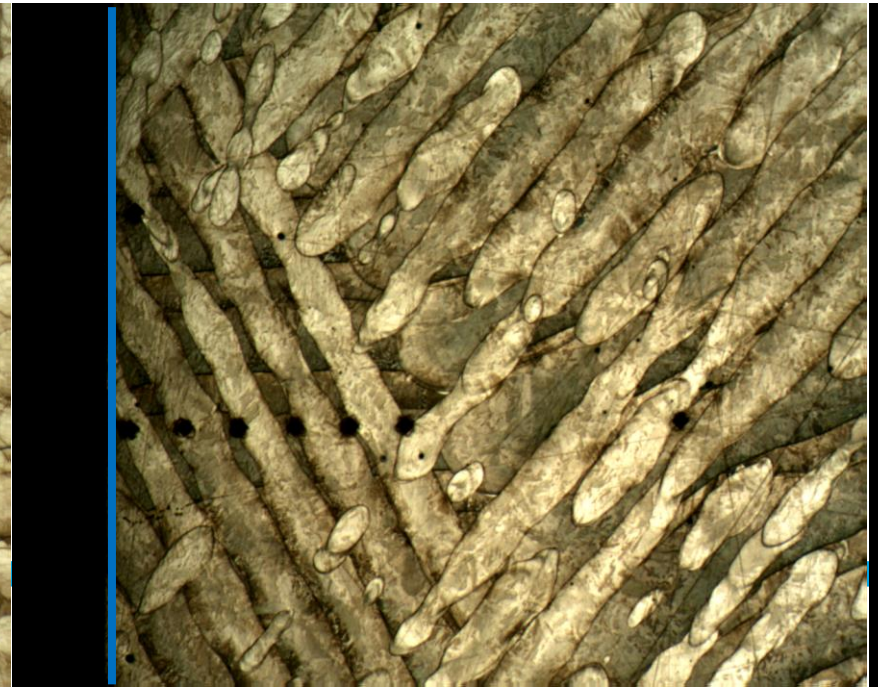

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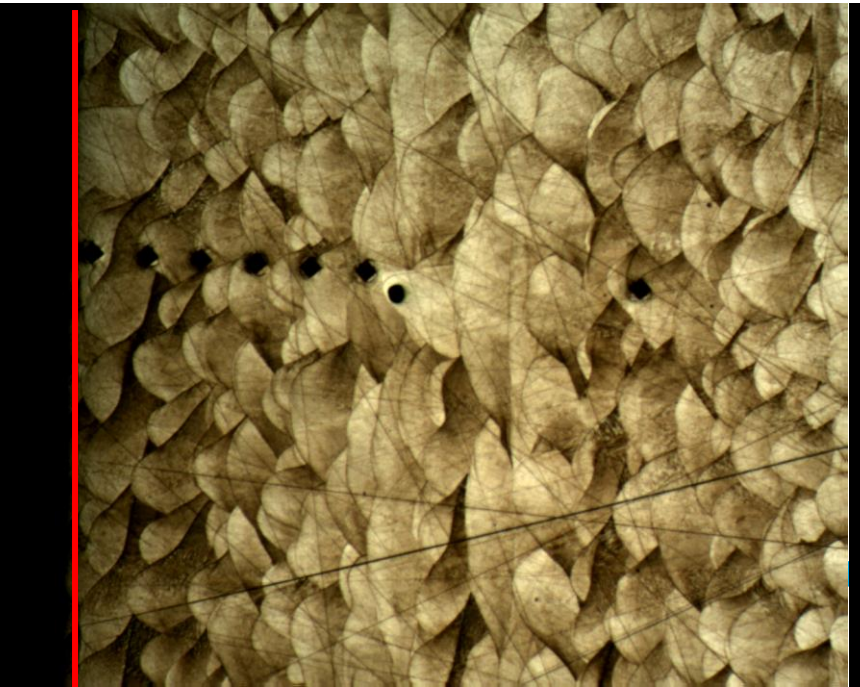
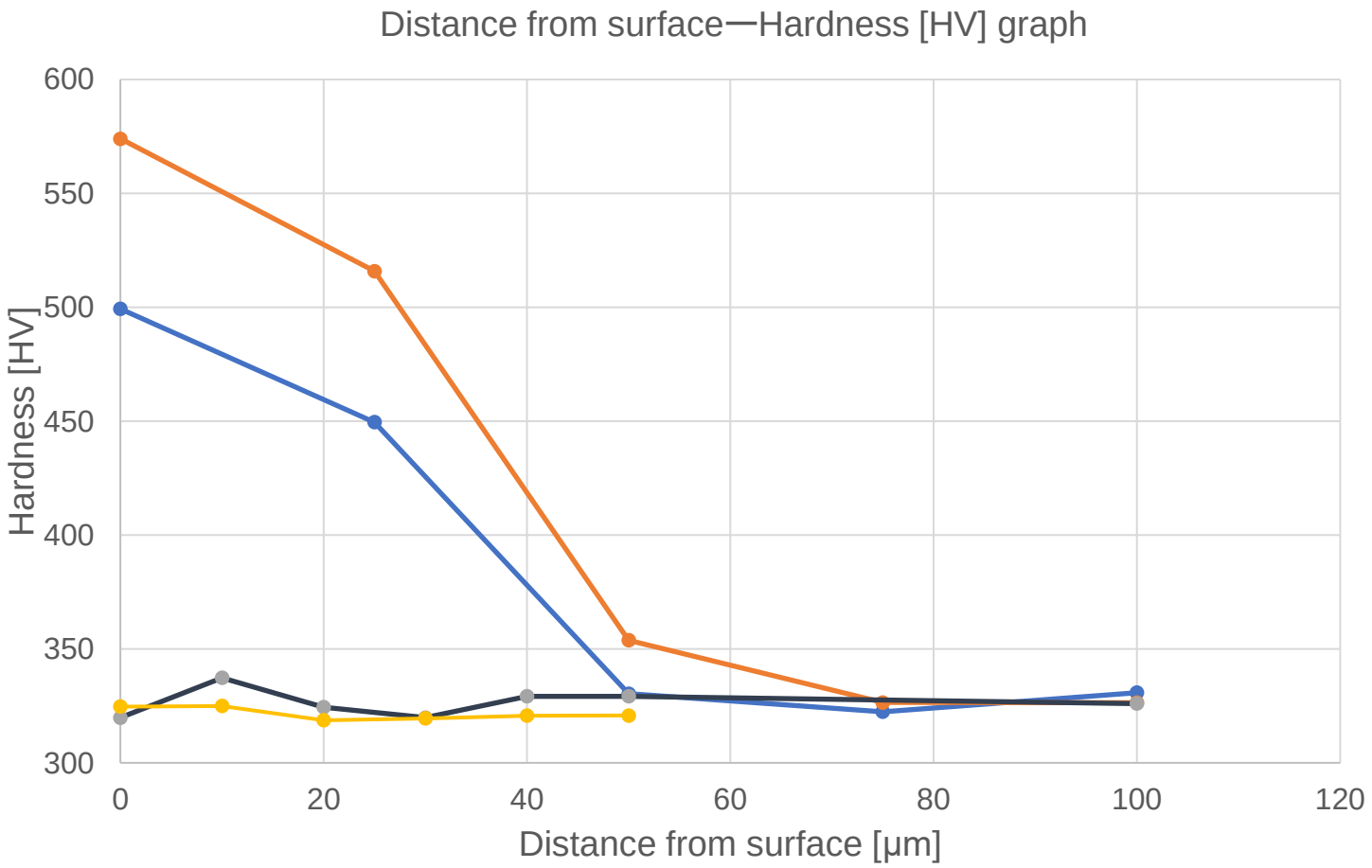
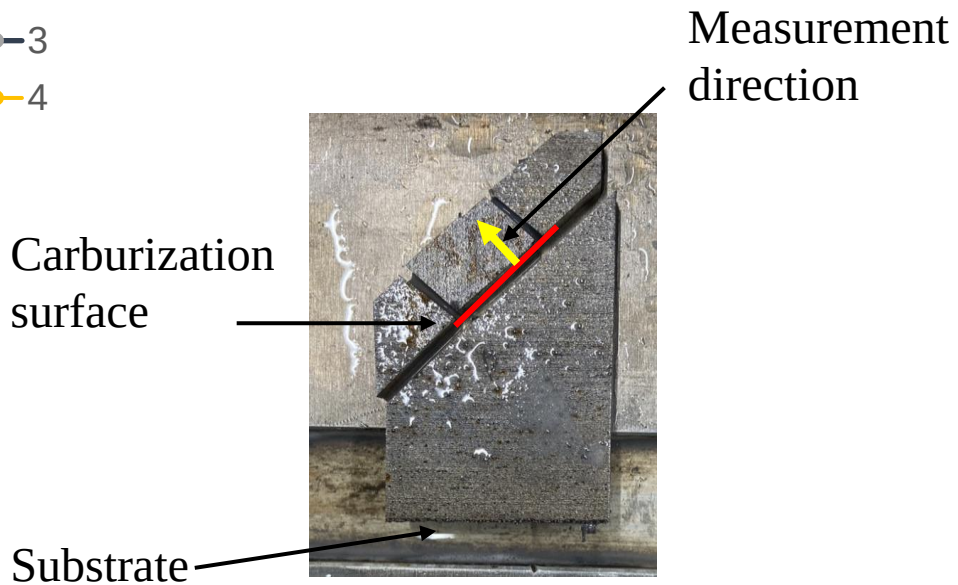




Heat treatment conditions
930℃ x 120 min
Acetylene flow rate 50[L/h]
Low pressure carburizing
Using diagonally cut material
Using various pulse conditions
1 : 10-5-10-5-10-80 [min]
2 : 15-15-15-75 [min]
3 : No carburizing heat treatment
4 : 60-60 [min]
*Red indicates acetylene inflow 50[L/h]
*Black indicates acetylene inflow 0 [L/h]



discussion

From the photographs, it can be predicted that the carburization speed and carburization depth may change depending on the direction of the grain structure.

From the graph, it can be seen that the hardness of maraging steel after carburizing heat treatment is approximately HV510 depending on the conditions, so it is similar to the hardness of general maraging steel after age hardening, regardless of the grain structure.

Future challenges and prospects

Investigation of anisotropy of grain structure with lamination method.

Relationship between carburizing speed and varying metal crystal grain properties.

Investigate tensile strength using tensile tests etc.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