Particle reinforcement of CoCrFeNi by targeted powder synthesis and selective laser melting

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H.-Y. Jung, E. Gärtner, V. Uhlenwinkel, E. Jägle, G. Dehm

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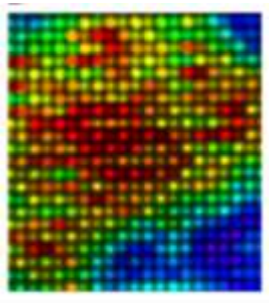
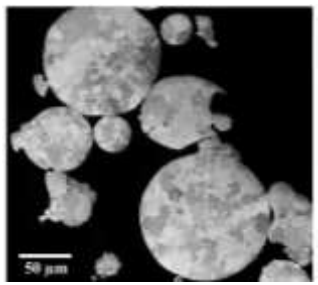


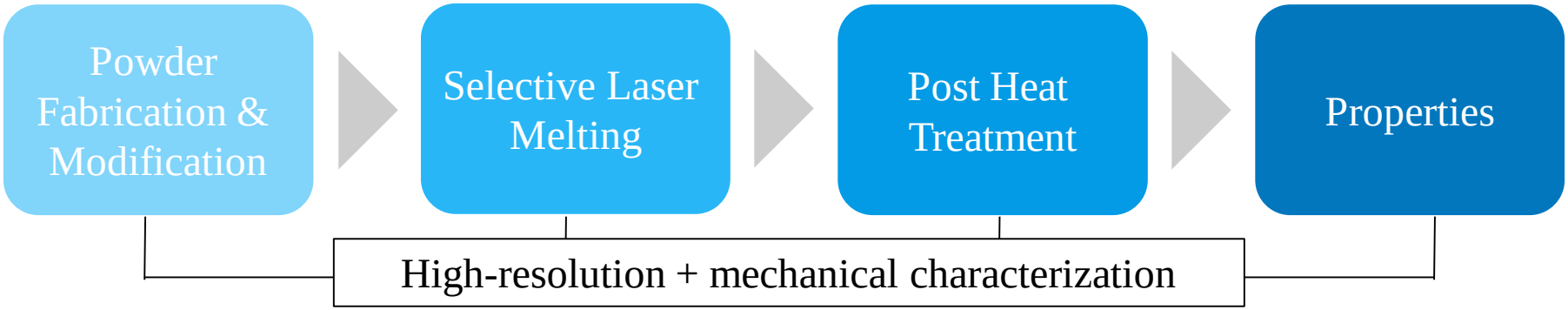


September 18th, 2018

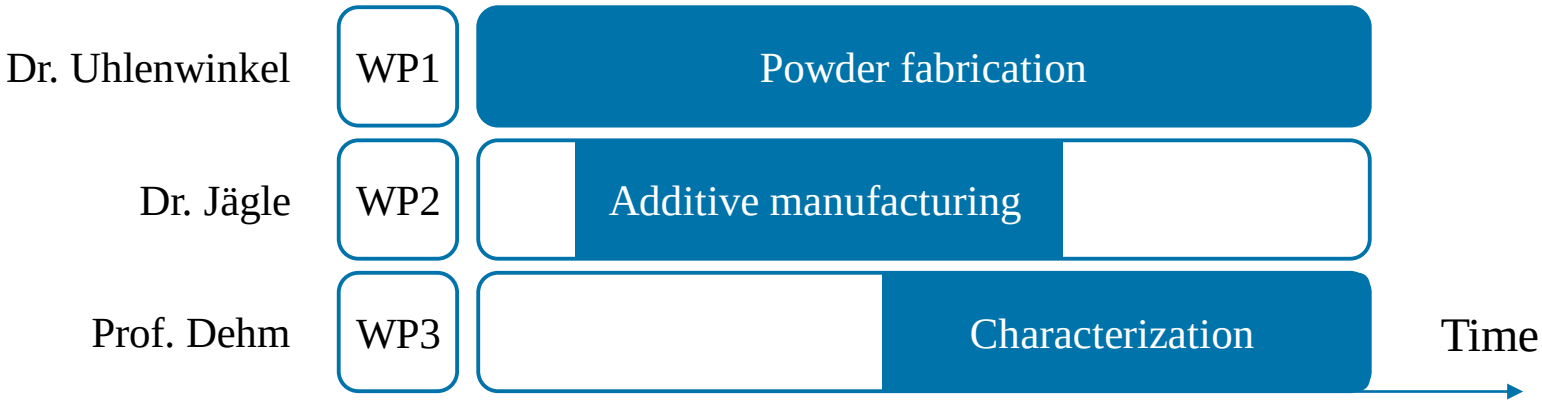
PaCCman ...

Particle strengthened **C**ompositionally **C**omplex Alloys

interlinking powder synthesis, additive **man**ufacturing, microstructure evolution and deformation mechanisms



Project course



IWT

CoCrFeNi

4 - Elements

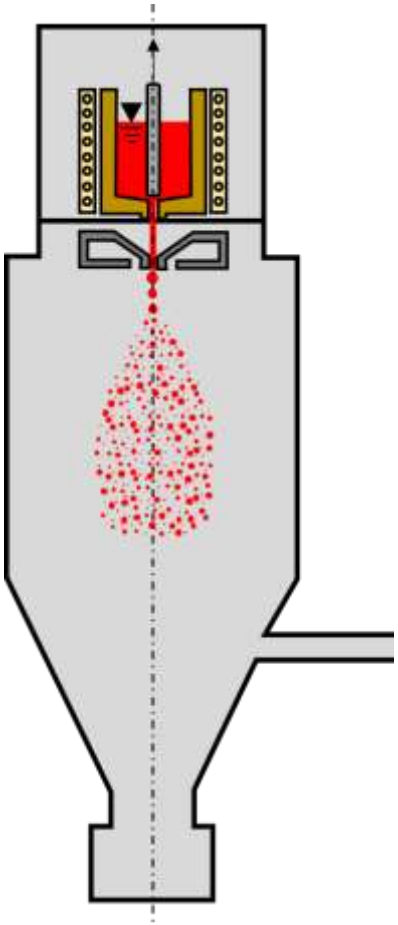
AlCoCrFeNi

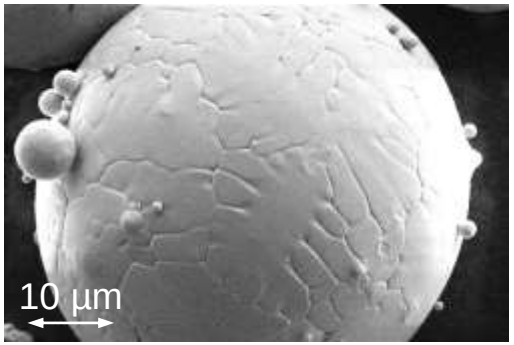
5 - Elements

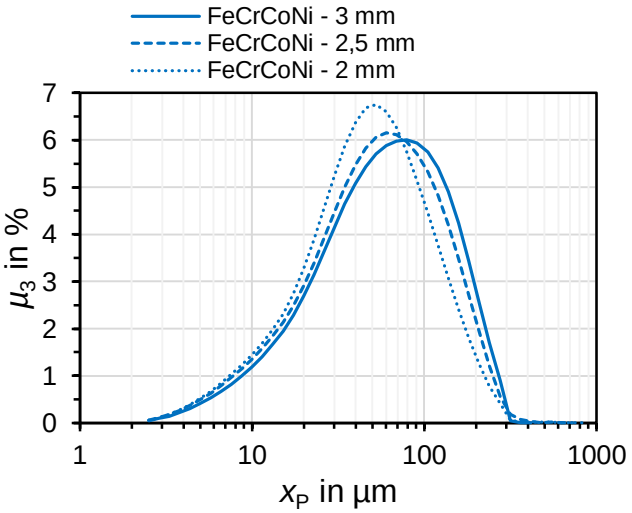
AlMnCoCrFeNi

6 - Elements

Gas atomization





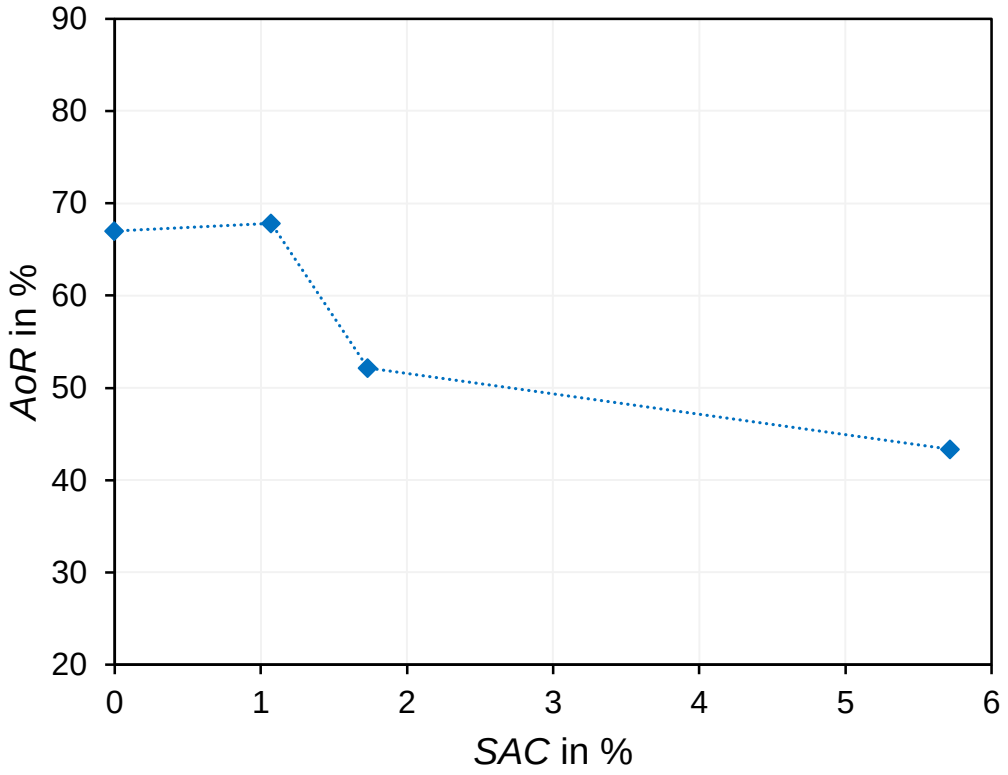


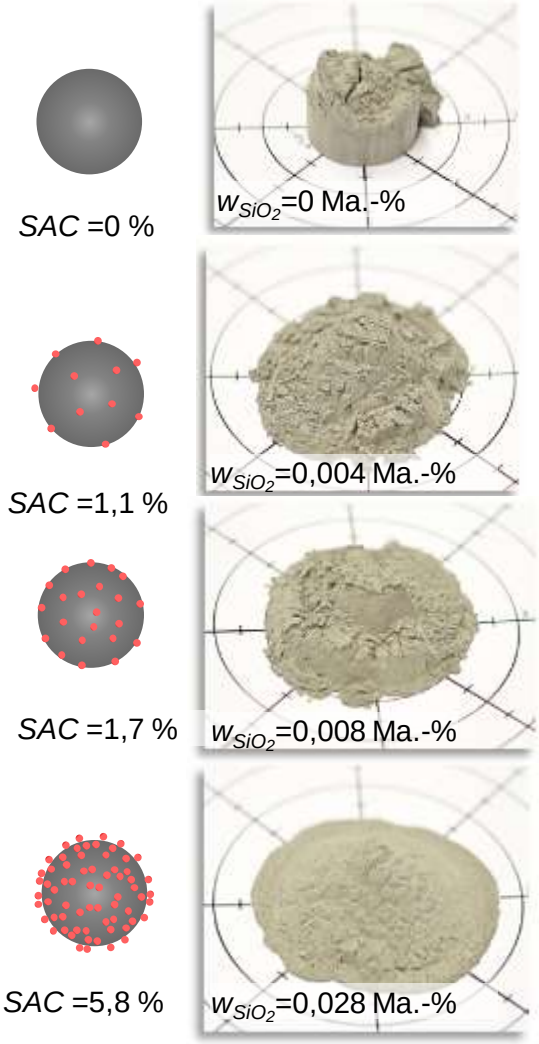
Actual flowability

Desired flowability

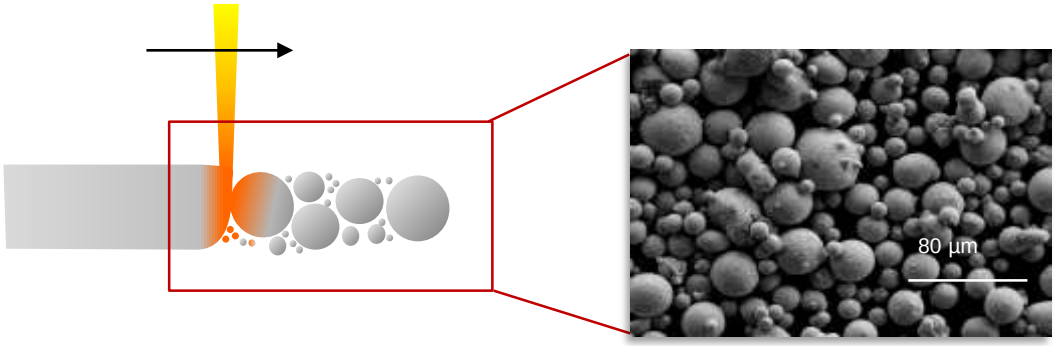
Adjusting flowability

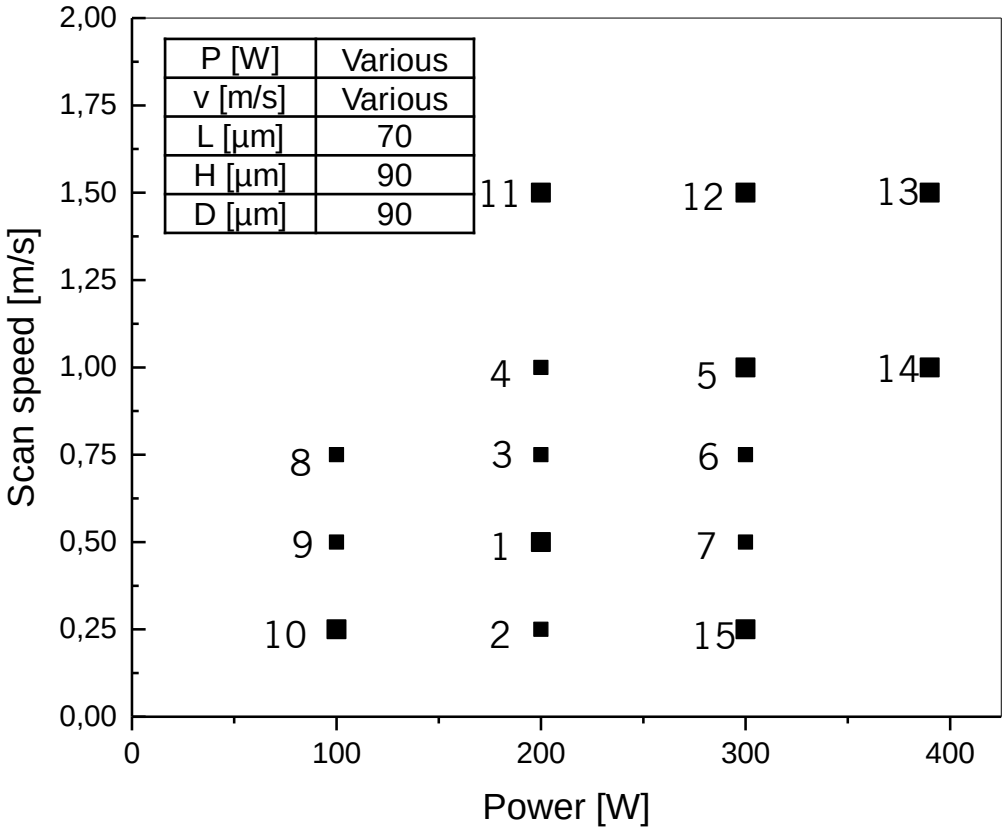
$$SAC = \frac{A_{Nano\ particle}}{S_{Metal\ particle}}$$

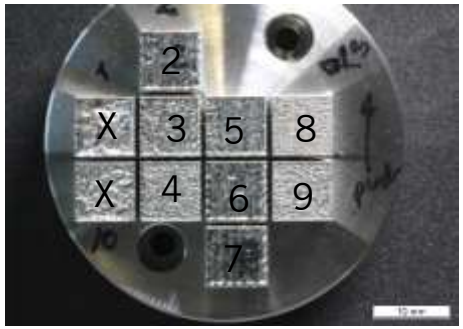


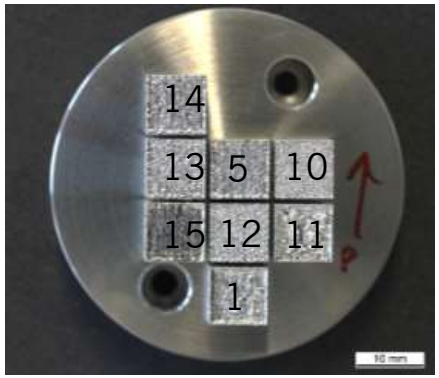


SLM parameters

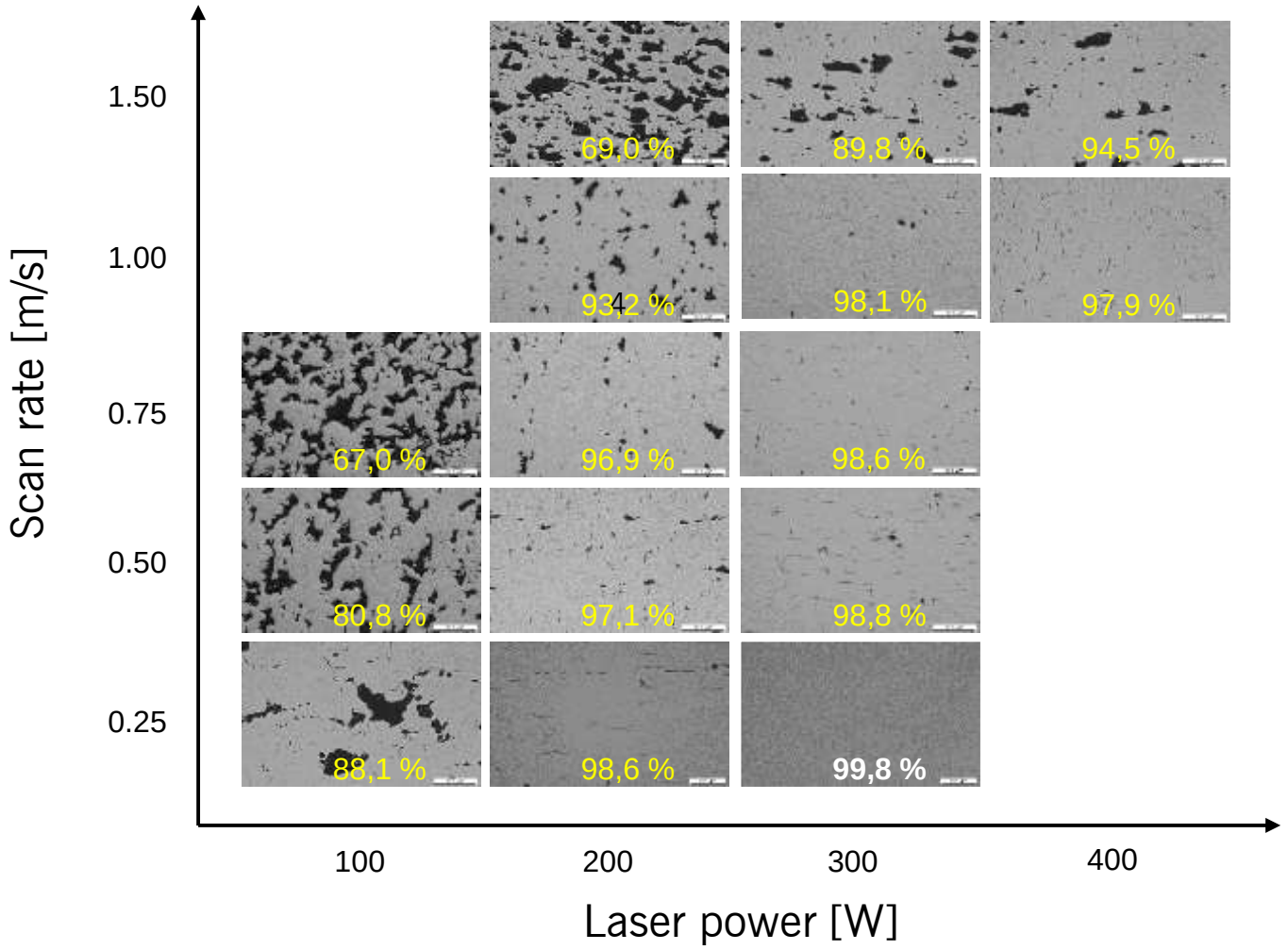




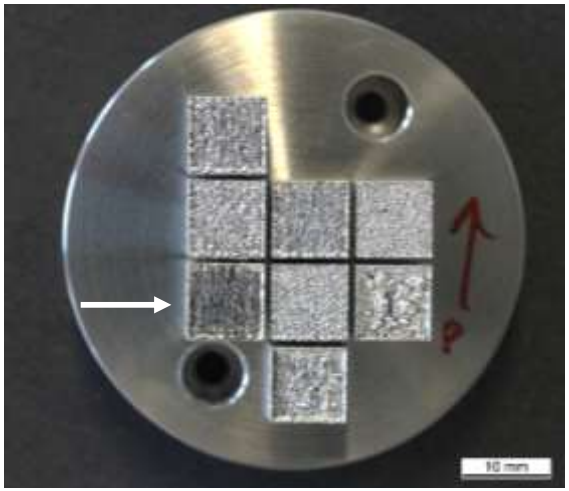


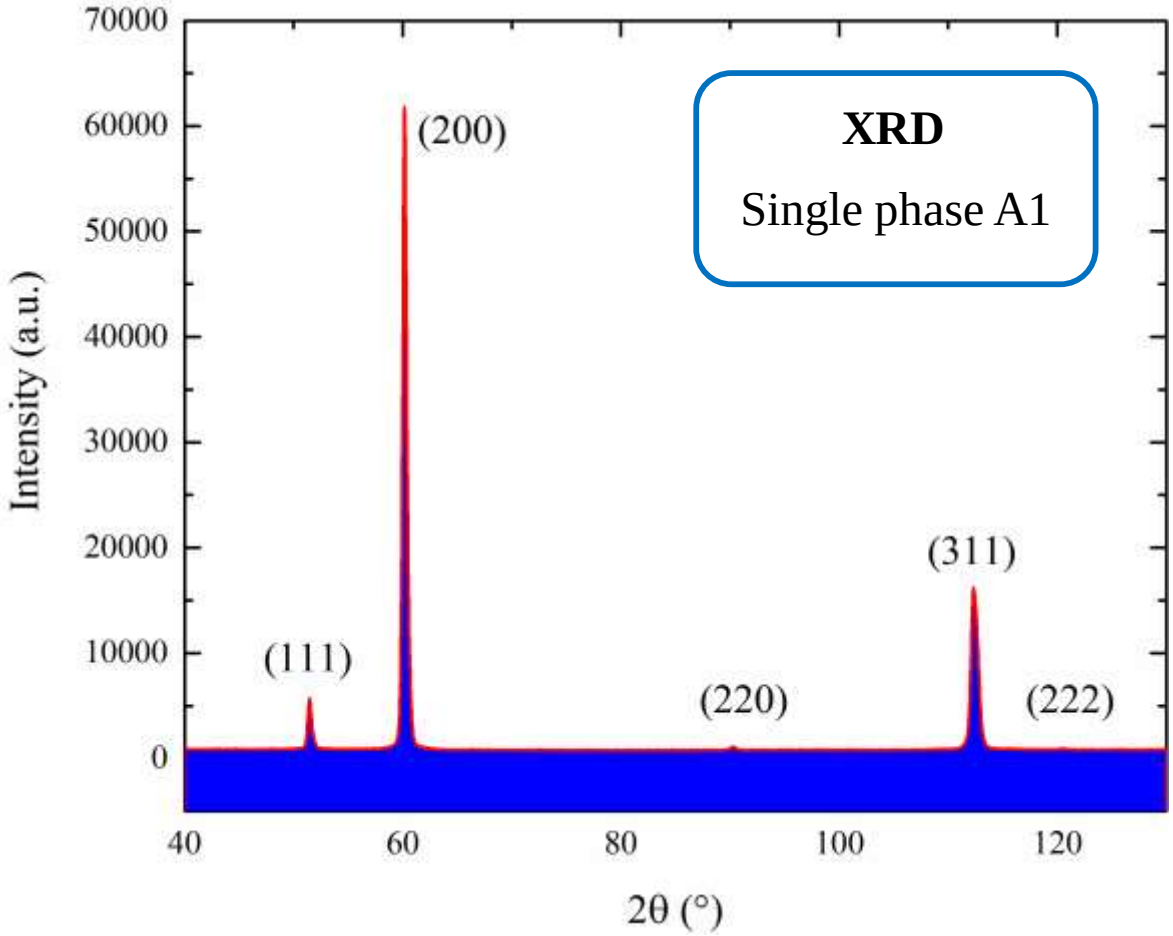


SLM processing

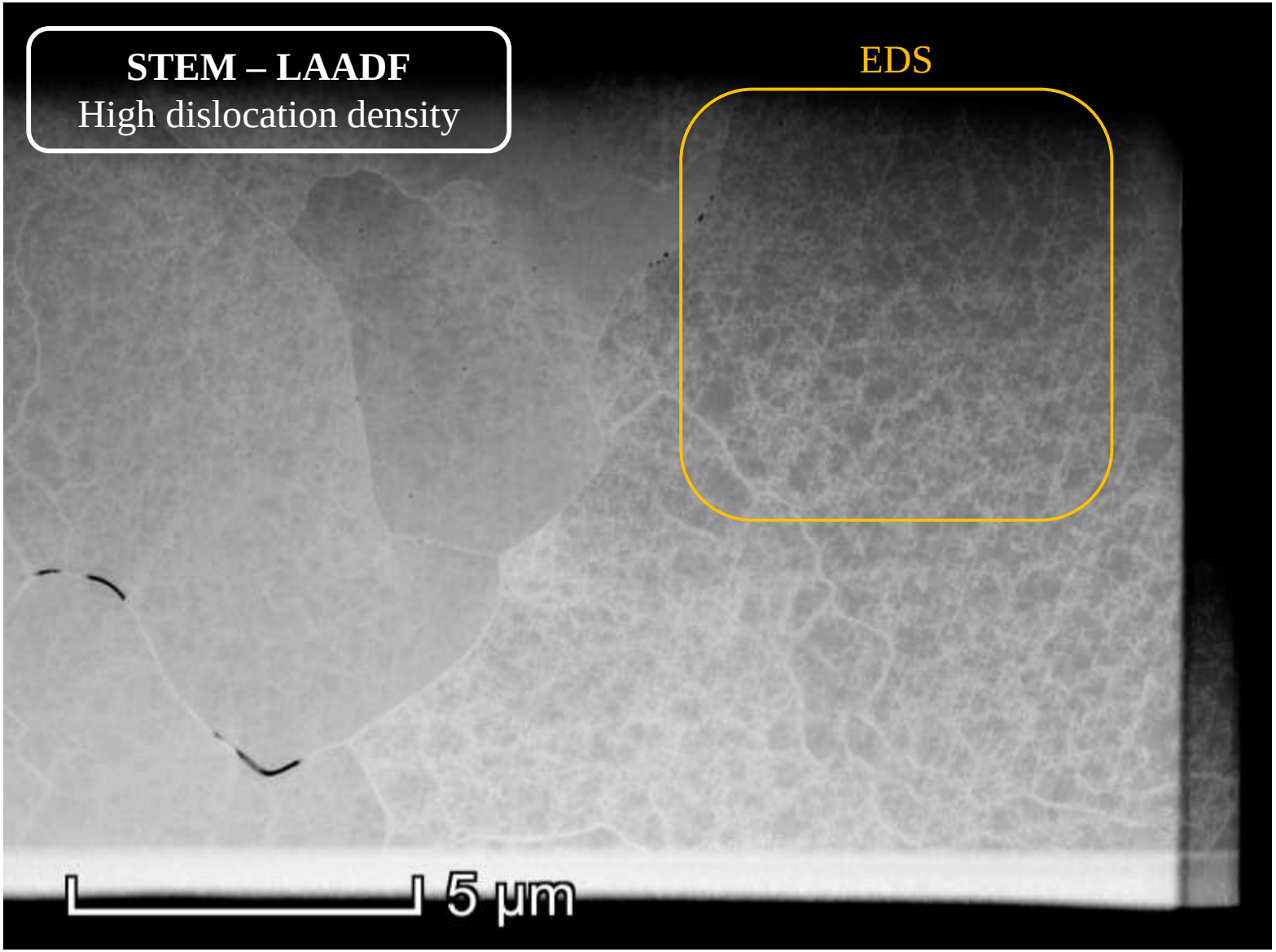


Characterization





Characterization

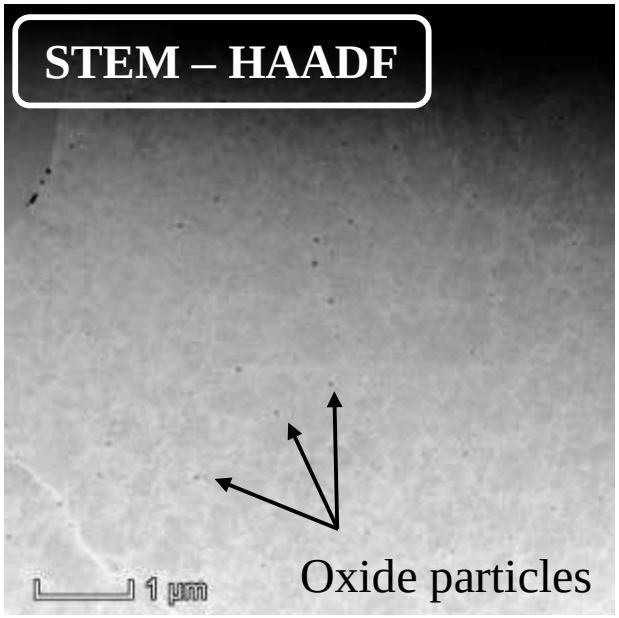


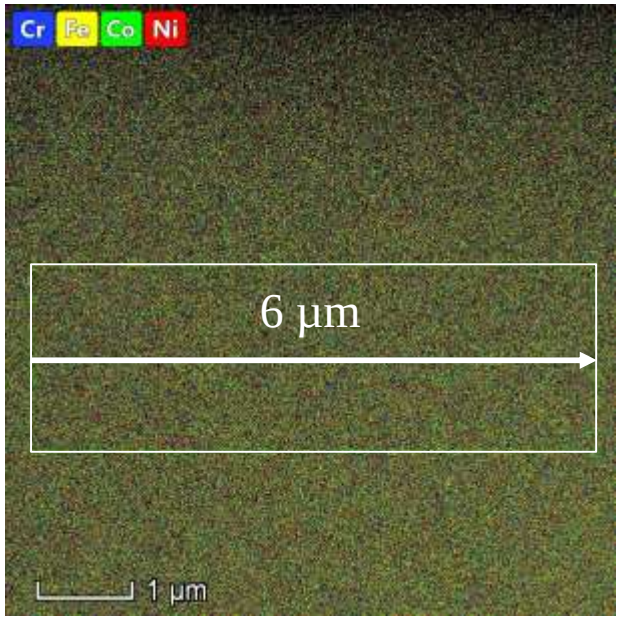
CoCrFeNi

Correct composition

&

Homogeneous distribution





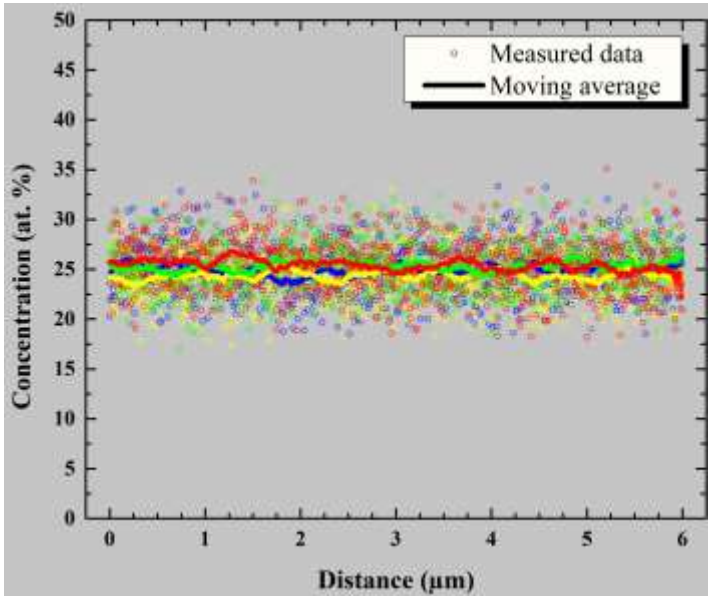
Desired elemental concentration 25 at. %

Cr
24.9 ± 2.6 at. %

Co
25.3 ± 2.4 at. %

Fe
24.4 ± 2.5 at. %

Ni
25.4 ± 2.7 at. %



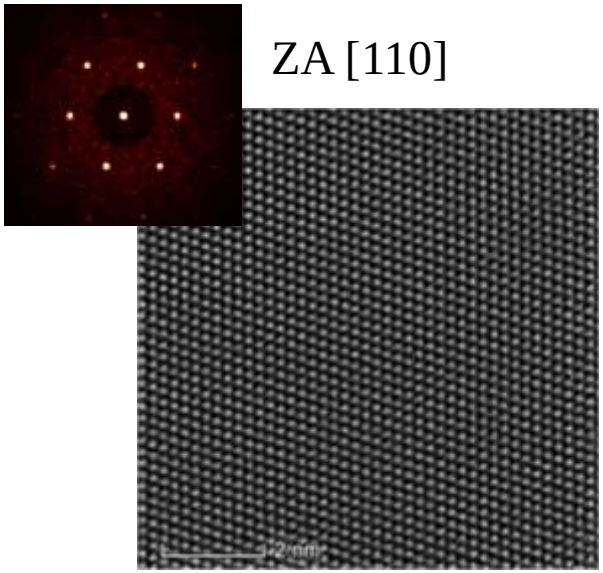
Characterization

Single phase

and

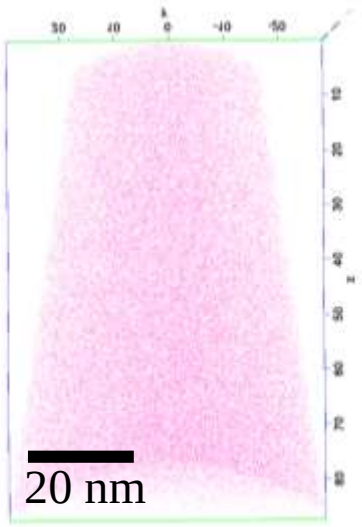
homogeneous composition

at nanoscale

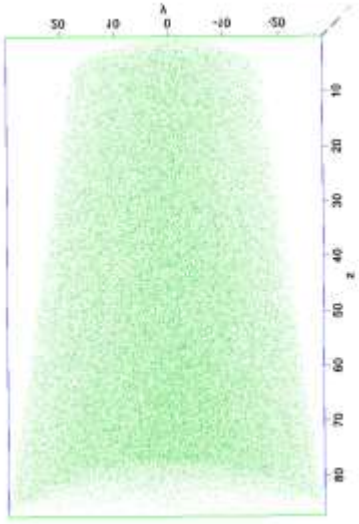


ZA [110]

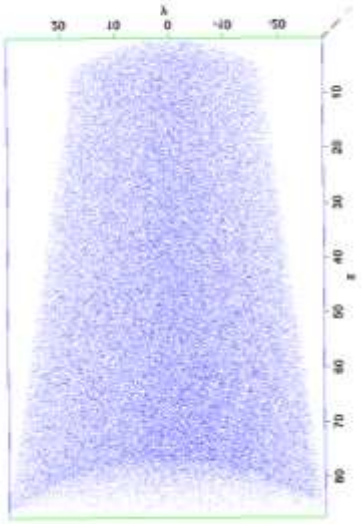
Fe



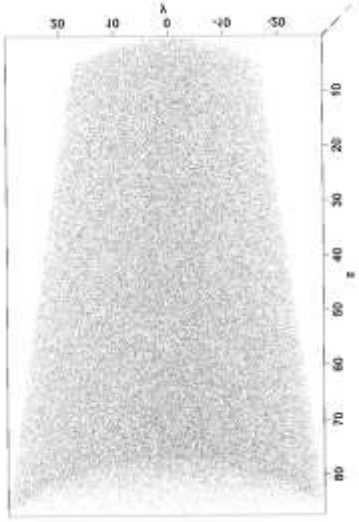
Ni



Co

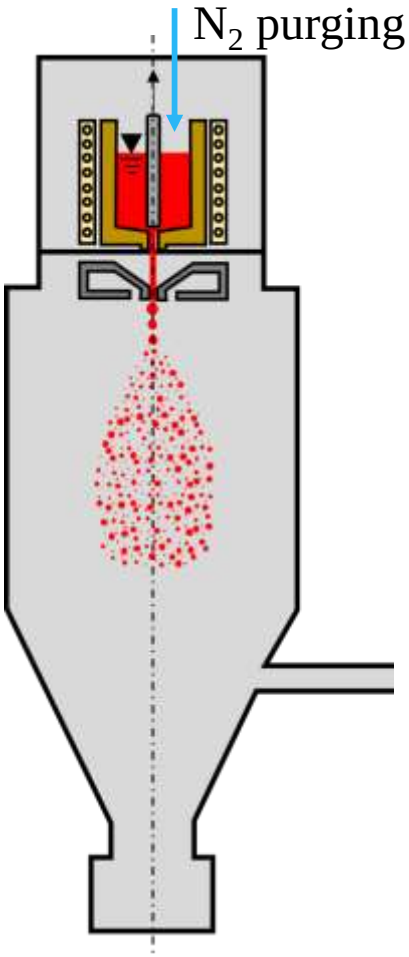


Cr

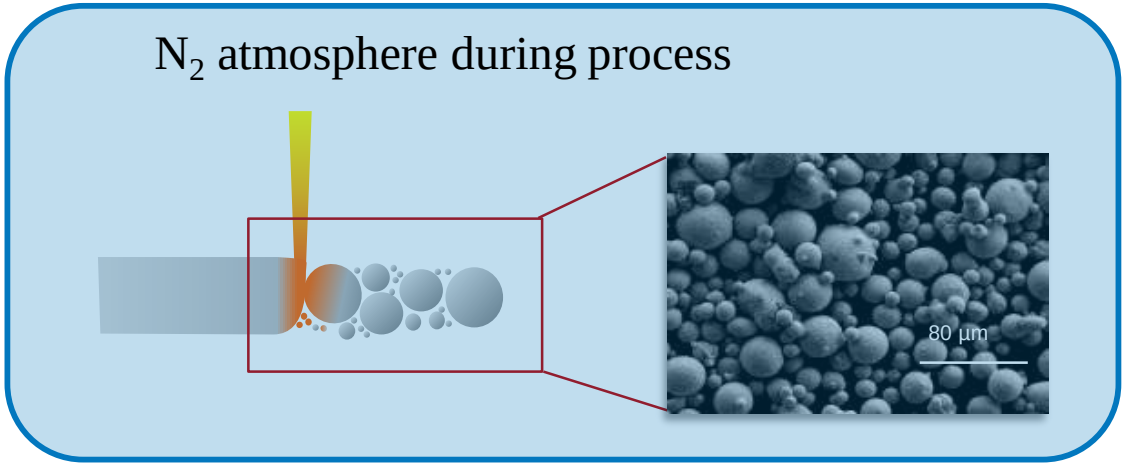


Nitriding

1. During atomization

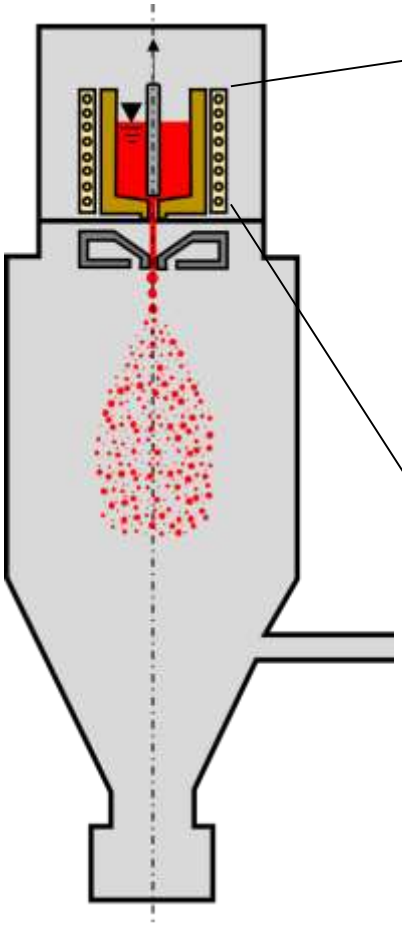


2. During atomization



Nitriding

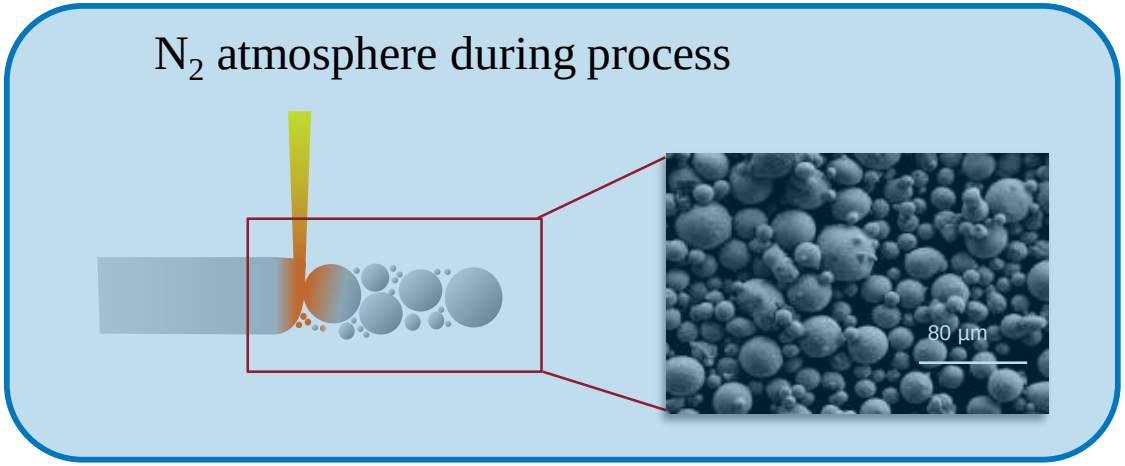
1. During atomization

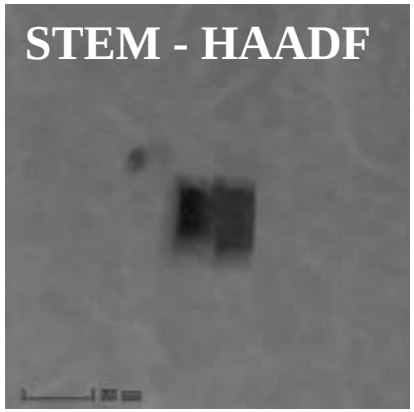


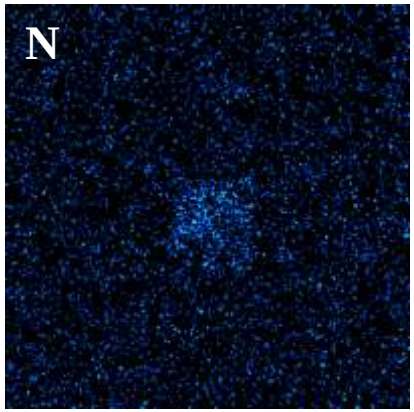
Purging rod
(N_2 supply)

Crucible with
cast ingot

Nitriding during atomization



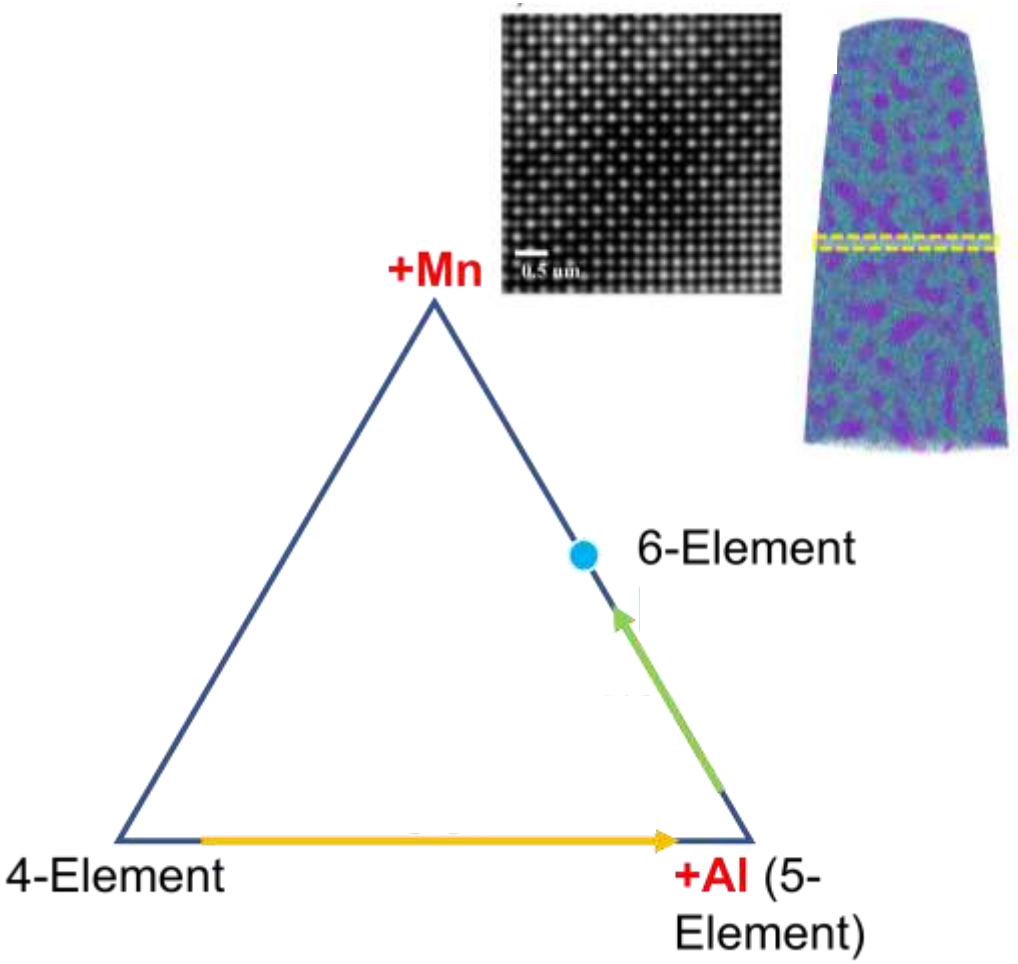




ca. 50 nm particles

Conclusion & Outlook

- Atomization & SLM optimized
- Single phase HEA
- High dislocation density
- Nitriding works



Deformation behavior by
in-situ SEM & in-situ TEM deformation

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PaCCman

"Coming together is a beginning. Keeping together is progress. Working together is success." – Henry Ford

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