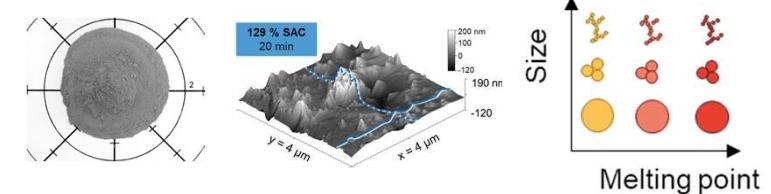


Synthesis of particle-reinforced CCA produced by additive manufacturing *(PaCCman to MarioCCart)*

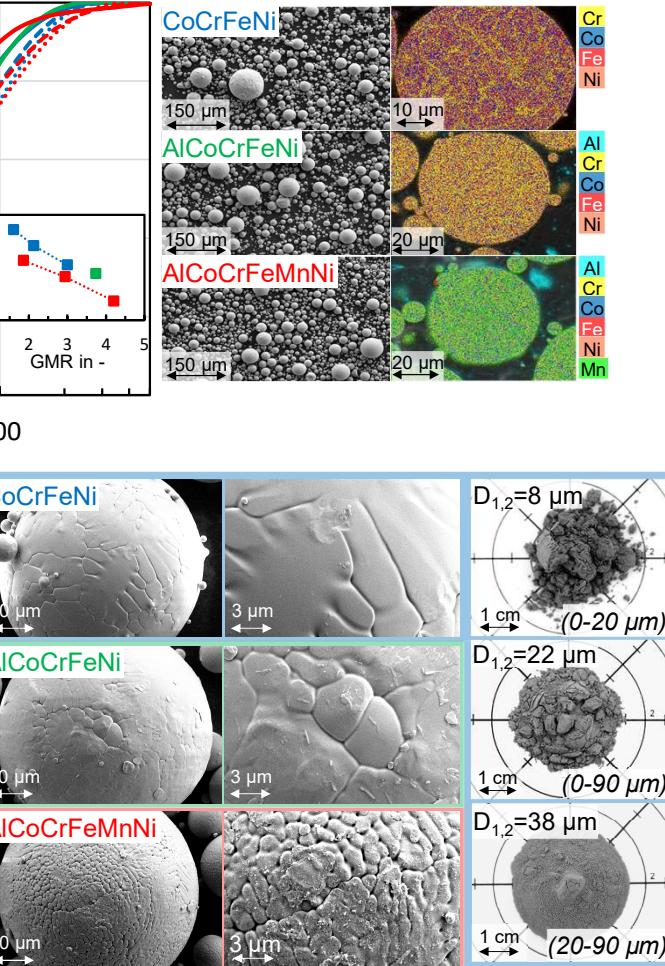
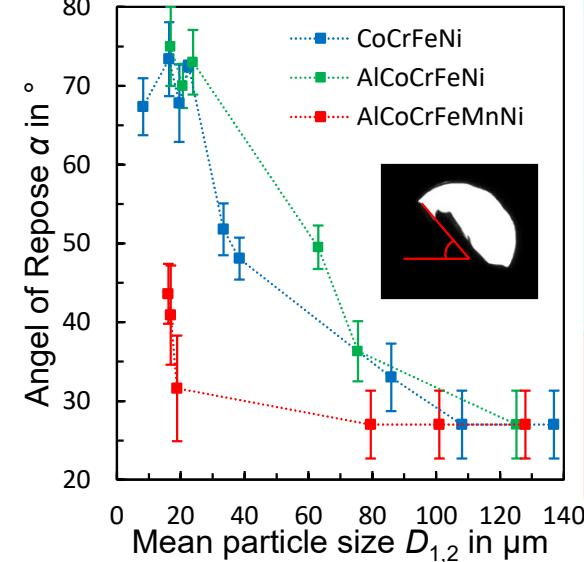
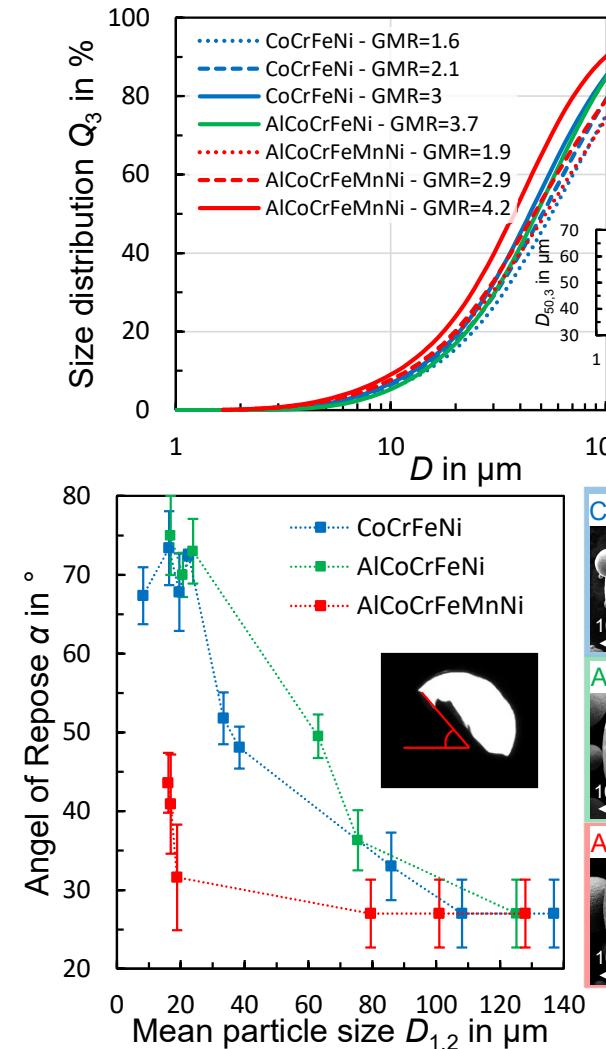
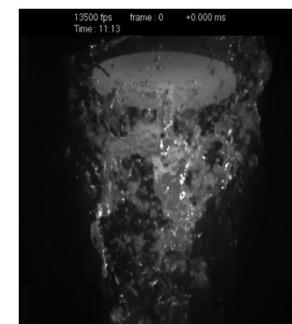
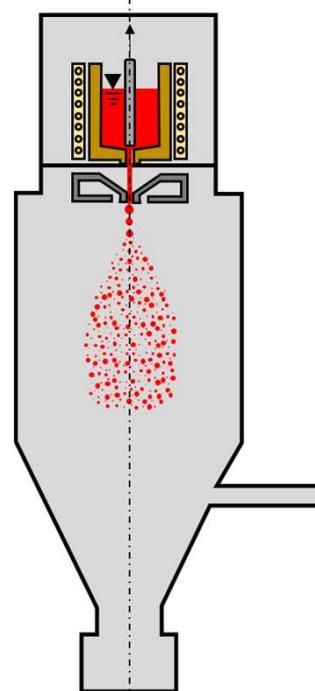
**Kick-Off Meeting for 2nd
Project Phase SPP2006
13.-14.04.2021**

Eric Gärtnert
Process & Chemical Engineering Division
Tel.: +49 (0)421 / 218-64502
E-mail: e.gaertner@iwt.uni-bremen.de



1st phase of SPP2006 - PaCCman

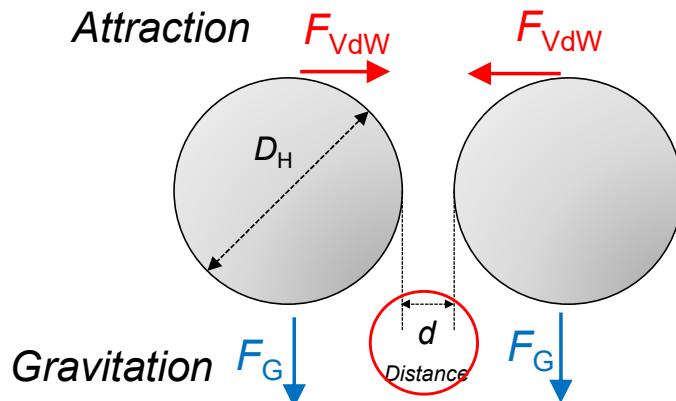
Synthesis of CCA powders



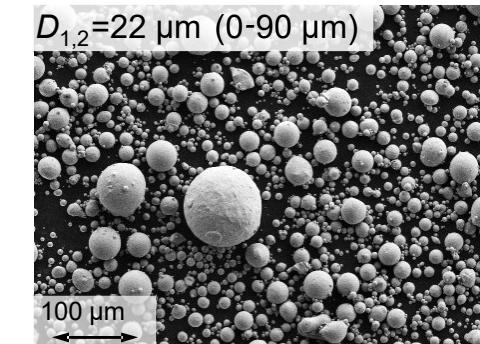
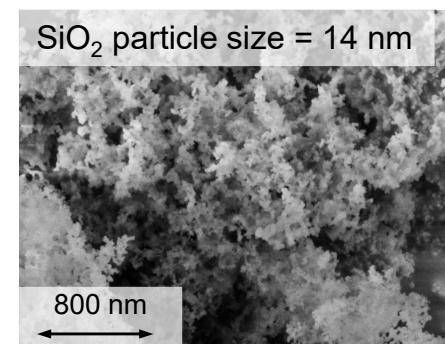
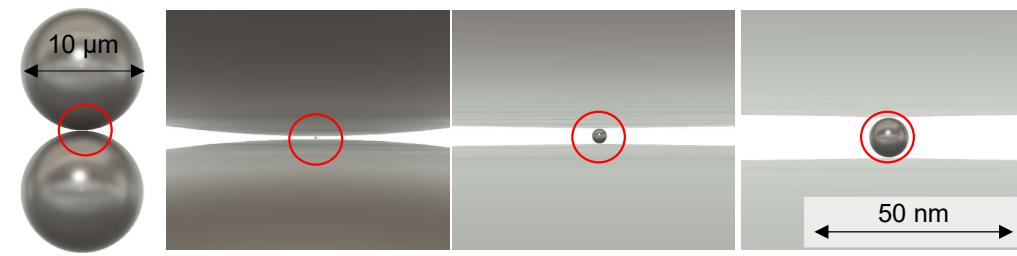
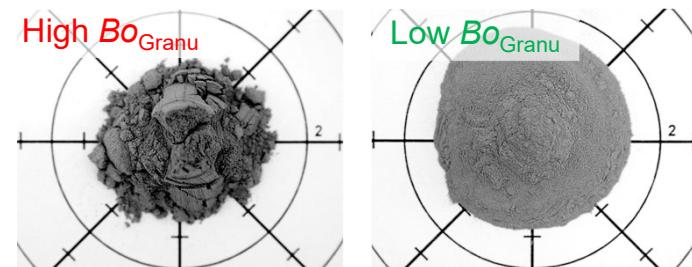
1st phase of SPP2006 - PaCCman

Overcoming low CCA powder processability

- CCA powder processability is critical to layer wise Laser-Powder-Bed-Fusion (LPBF) and Additive Manufacturing (AM)



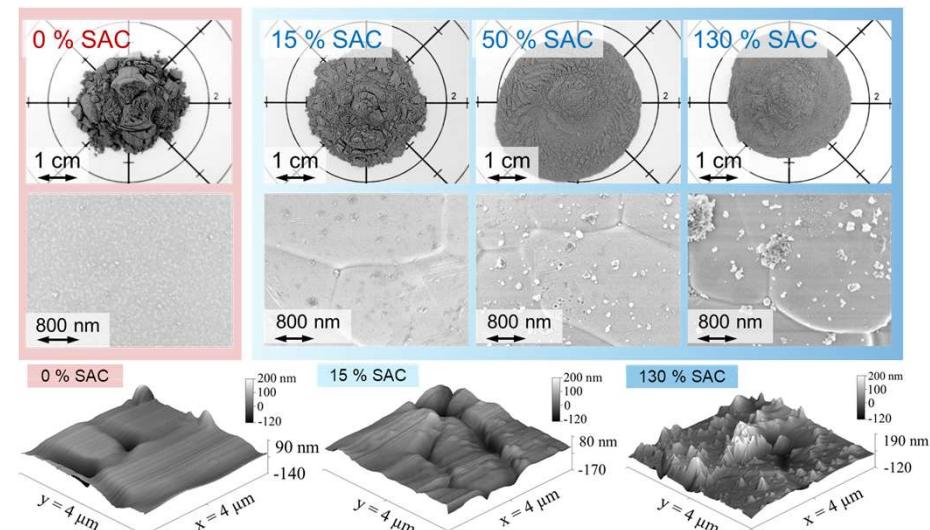
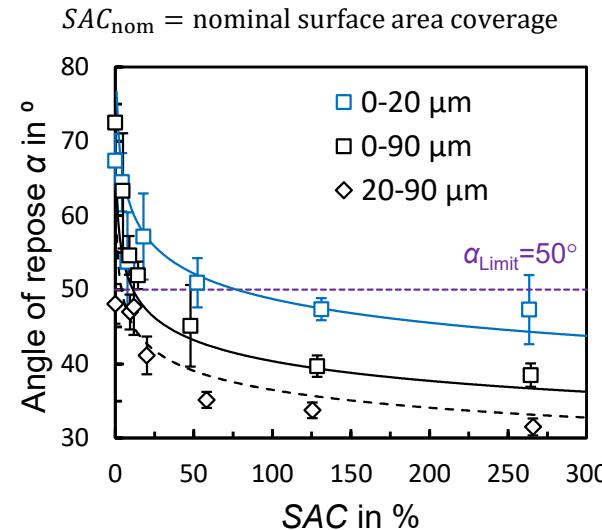
$$Bo_{Gran} = \frac{F_{VdW}(d_{Distance})}{F_G}$$



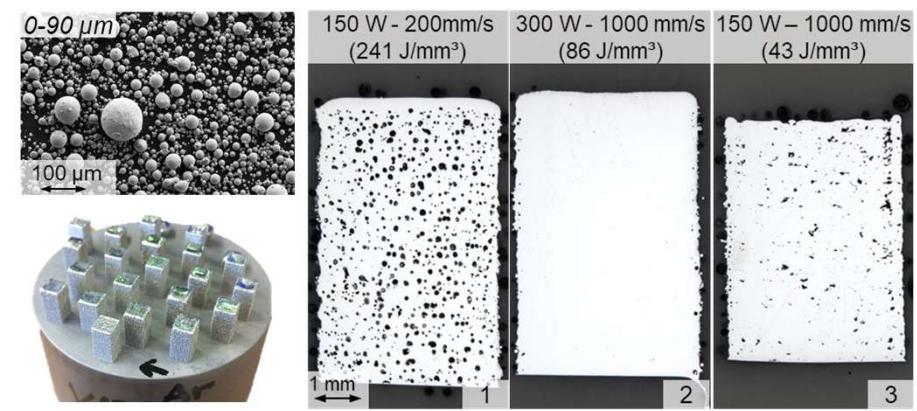
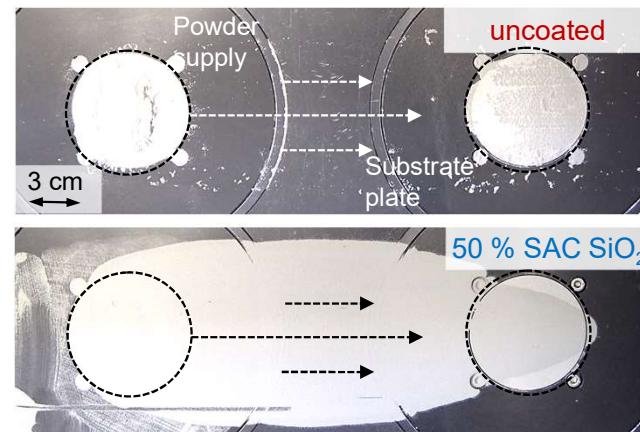
1st phase of SPP2006 - PaCCman

Nanoparticle coating enabled Additive Manufacturing of CCA

- Improved processability via nanoparticle coating



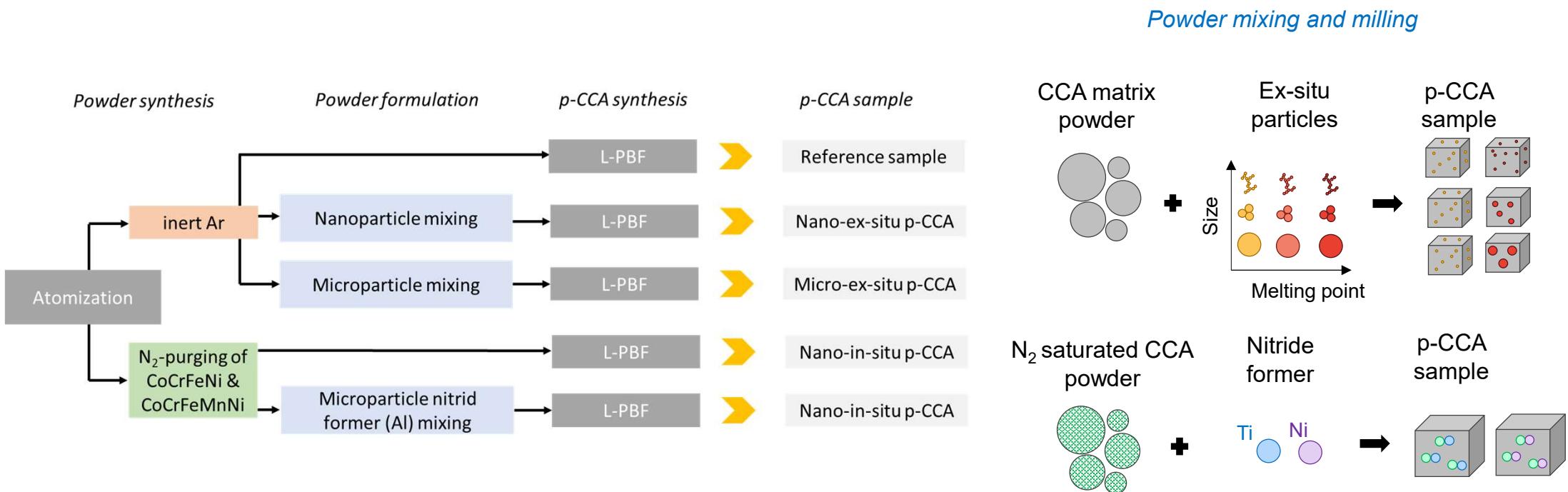
- Additive manufacturing of CCA cm-scaled samples



2nd phase of SPP2006 - MarioCCart

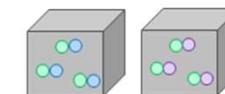
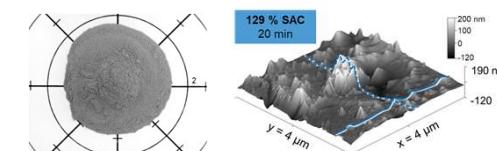
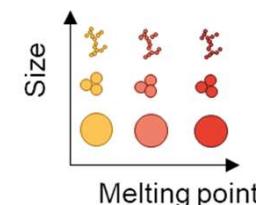
Synthesis routes of p-CCA

Title: Mechanical properties and hydrogen tolerance of particle-reinforced CCA produced by additive manufacturing (MarioCCart)



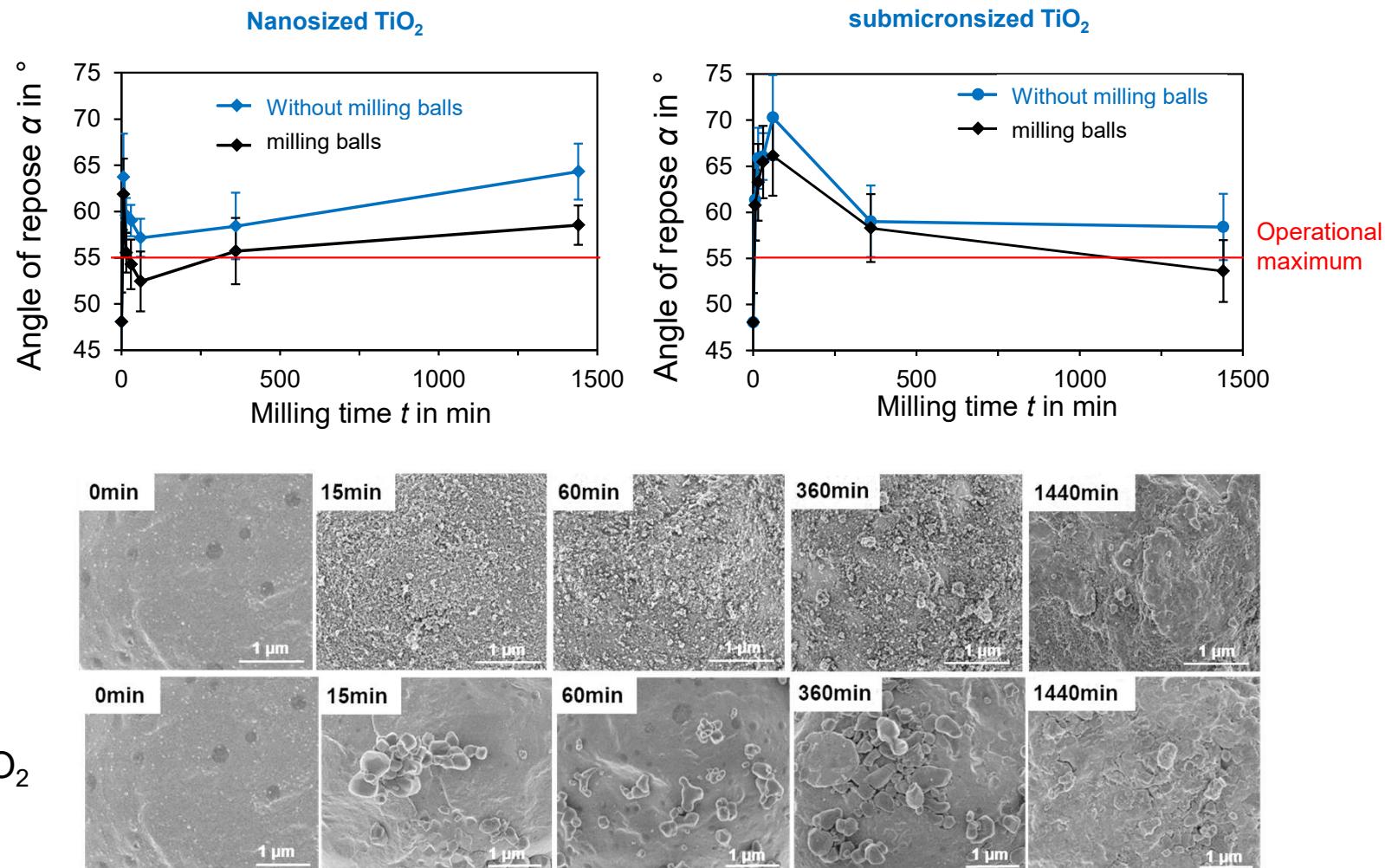
MarioCCart Hypthesis for p-CCA processing

- L-PBF processing is able to introduce a high number density of nanoparticles homogeneously distributed into the chosen matrices.
- High melting point nanoparticles sustain L-PBF process temperatures and can be incorporated into HEA matrices.
- The flowability enhancement properties of nanoparticles are strongly dependent on the nanoparticle size, chemistry (via the particle-interaction and density) and concentration.
- Additional nitride forming elements in the form of micropowders (e.g. Al, Ti) can be used to produce p-CCA by L-PBF of nitrogen saturated CCA powder.



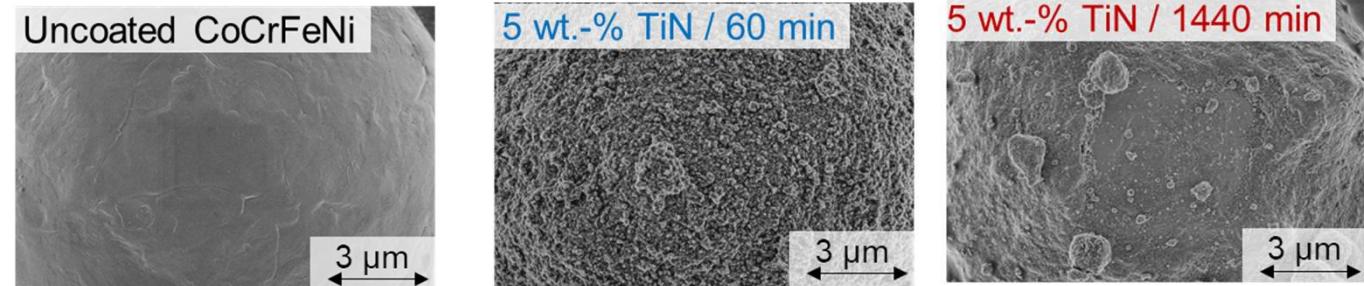
High loading of ex-situ particle (316L Steel + TiO) effecting processability

- Powder interactions change during milling and greatly affect processability

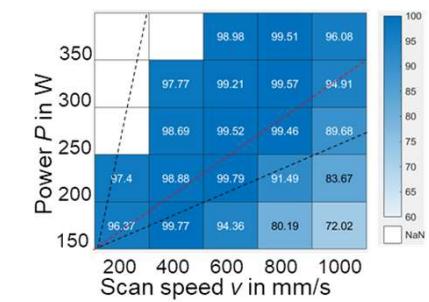
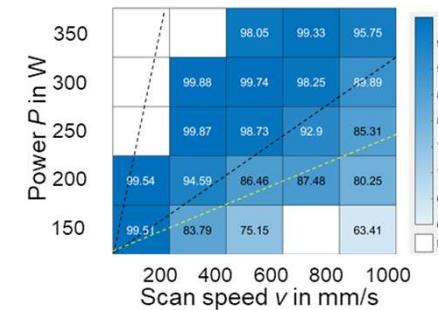
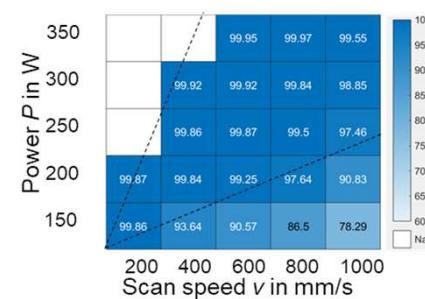
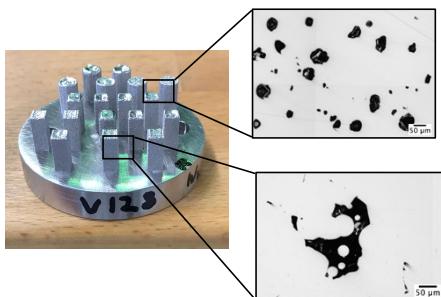


LPBF sample quality of high particle loaded powders

LPBF machine @IWT



Porosity and defect classification



Summary

- p-CCA sample synthesis via gas-atomization and additive manufacturing (AM)
- nanoparticle powder formulation enables powder processability for AM
- particle-reinforcement via dry-coating of ex-situ particles
- AM of nitrogen saturated CCA powders and nitride formers aims at in-situ particle reinforcement

Synthesis of particle-reinforced CCA produced by additive manufacturing *(PaCCman to MarioCCart)*

Eric Gärtner

Leibniz-Institute for Materials Engineering IWT
Process & Chemical Engineering Division
Building IW1+2, Room 1120
Badgasteiner Str. 1-3
28359 Bremen, Germany

Tel.: +49 (0)421 / 218-64502
E-mail: e.gaertner@iwt.uni-bremen.de