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Ceramic Powder Technology

Advanced battery materials by spray pyrolysis

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Nordbatt
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Introduction to CerPoTech

About CerPoTech

What?	High-quality complex oxide powders
Why?	Superior quality, tailor-made materials
Where?	Tiller, Norway
How?	Spray-pyrolysis based on aqueous solutions

History of CerPoTech

2003	Spray pyrolysis unit installed at NTNU
2007	CerPoTech founded in Trondheim, Norway
2013	Pilot production facility established

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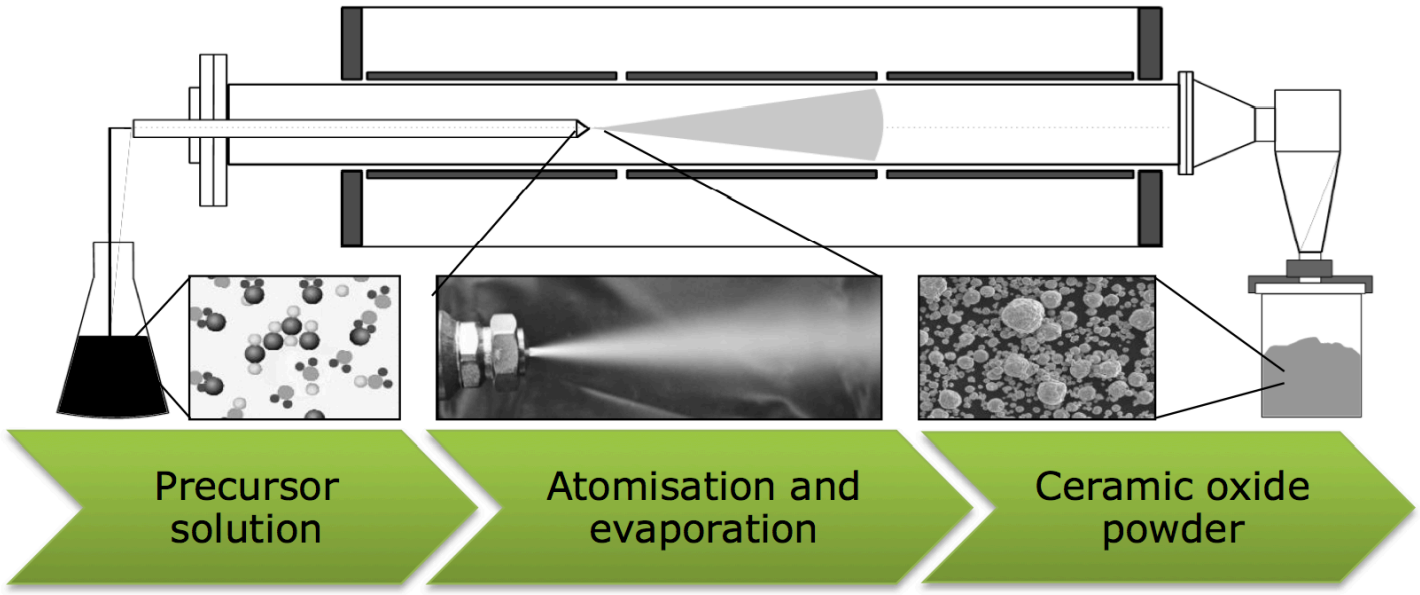
Production Process



- Spray pyrolysis is CerPoTech's core technology.
- The precursor chemistry, the pyrolysis equipment and know-how make it unique.
- The spray pyrolysis technology allows for a seemless up-scale of the from pilot scale production to industrial size.

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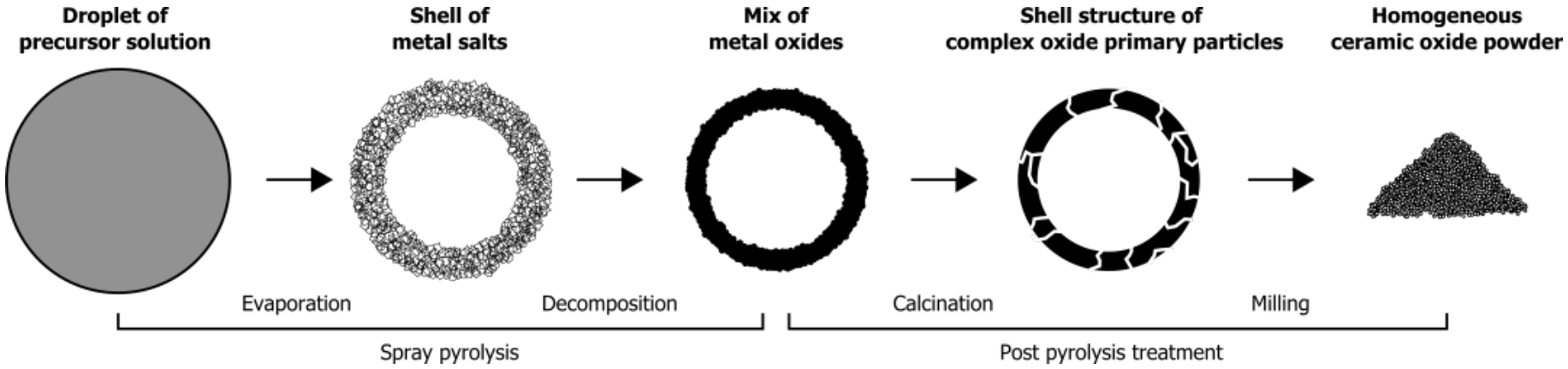
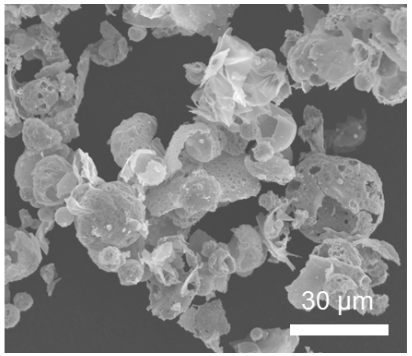
Production Process



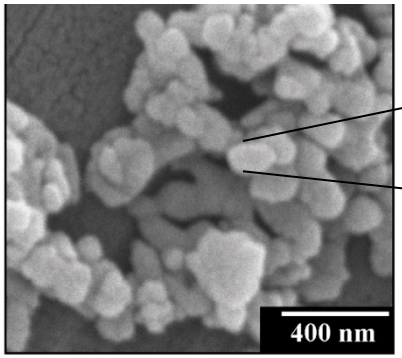
As-produced



5-50 µm

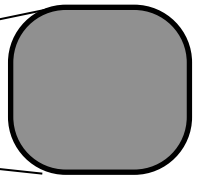
Milling

Particles



0.1-2 µm

Crystallites



10-500 nm

Specific surface area in the range 1-100 m^2/g

Exact specification depending on material and post treatments

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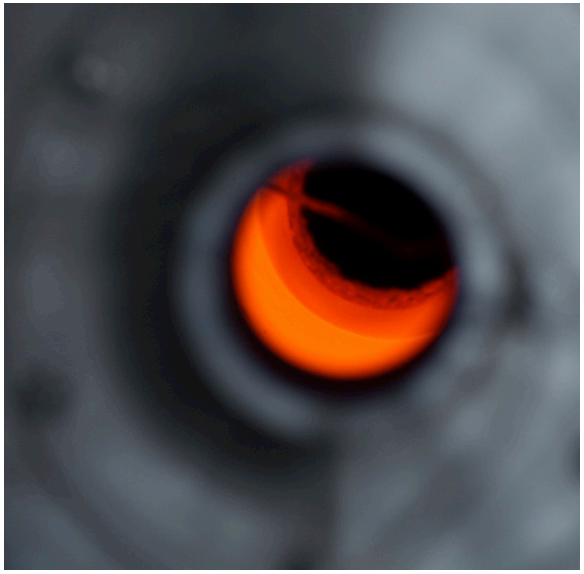
Production Capacity


- Complete process chain from raw chemicals to finished powder
- Current capacity approx. 5.000 kg per year, typical lead time 4-6 weeks
- Wide range of compositions can be synthesized
- High batch to batch consistency

Powder specifications:

- High phase purity
- Very homogeneous powders
- Exact stoichiometry
- Very low level of contaminants
- Excellent sinterability -> reduced processing temperature

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The Periodic Table of CerPoTech

H																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo

*	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
**	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

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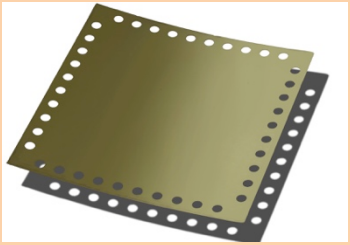
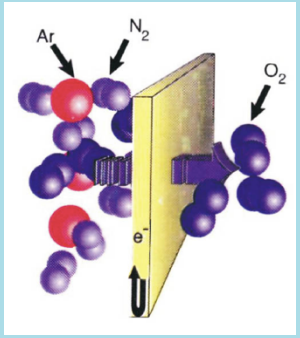
Applications

Energy



SOFC / SOEC
Batteries
Supercapacitors
Superconductors

Environmental



Membranes
Catalysts
Photocatalysts

Electronics

Lead-free
electro ceramics
Lead-free
piezo ceramics
Others

“Toolbox”

Custom-made
materials for
R&D and novel
applications

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Current R&D projects

- EVOLVE
  - **EVOLVE**d materials and innovative design for high-performance, durable and reliable SOFC cell and stack.
- AMSCOPPER
  - Anti-microbial photocatalytic coatings for e.g. hospitals.
- COATELY
  - High performance coatings for PEM electrolyser metallic bipolar plates.
- ZAS
  - **Z**inc-**A**ir **S**econdary batteries based on innovative nanotechnology for efficient energy storage

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SEVENTH FRAMEWORK PROGRAMME

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CerPoTech's battery materials

Battery oxide materials

Advanced ceramic oxide materials

Zn-air batteries

-> Oxygen
Reduction/Evolution Catalysts

Li-ion batteries

-> Li-based oxides

Battery oxide materials

Advanced ceramic oxide materials

Zn-air batteries

-> Oxygen
Reduction Evolution Catalysts

Very good expertise

Li-ion batteries

-> Li-based oxides

No experience yet, but we have the potential

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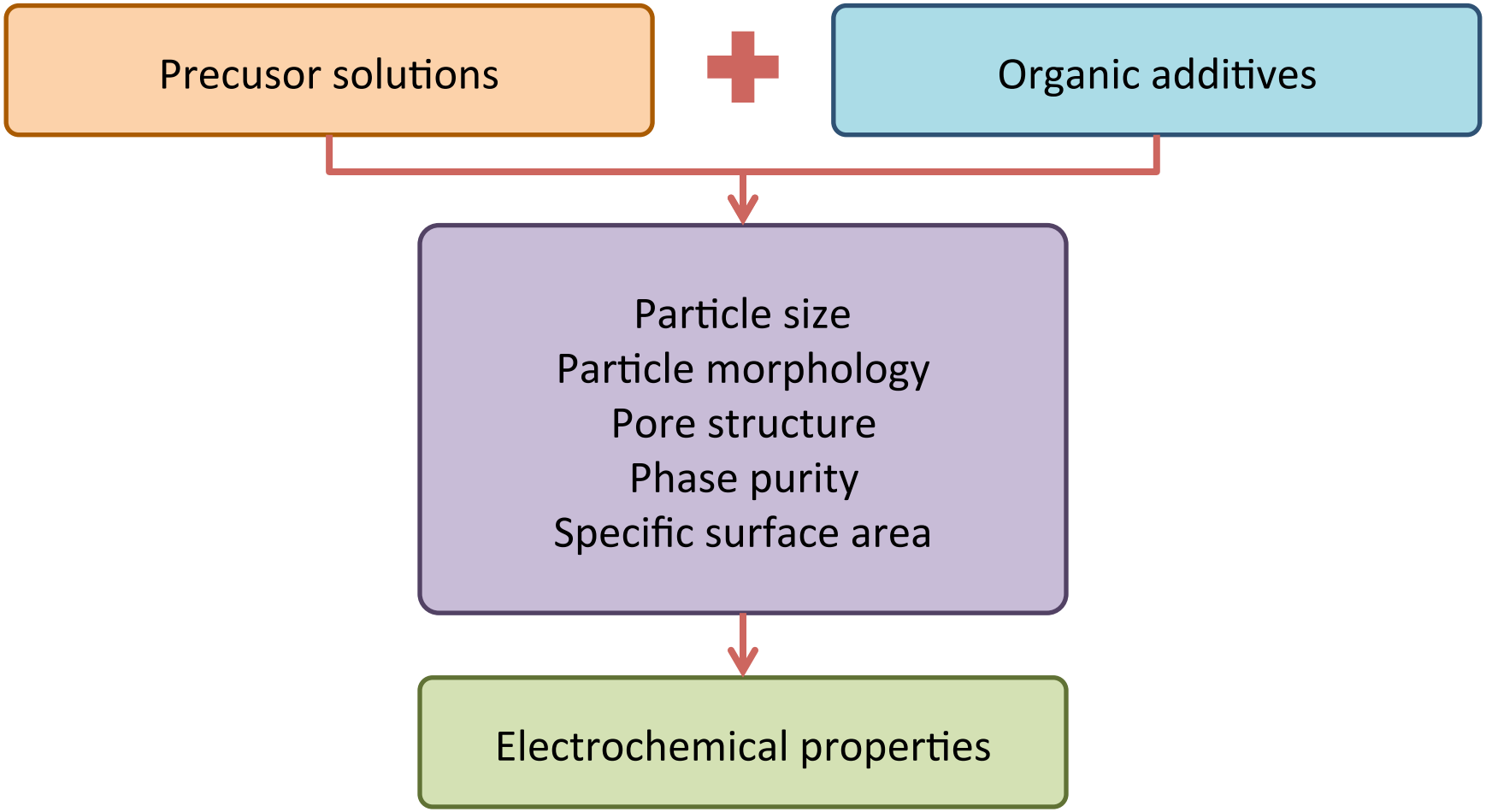
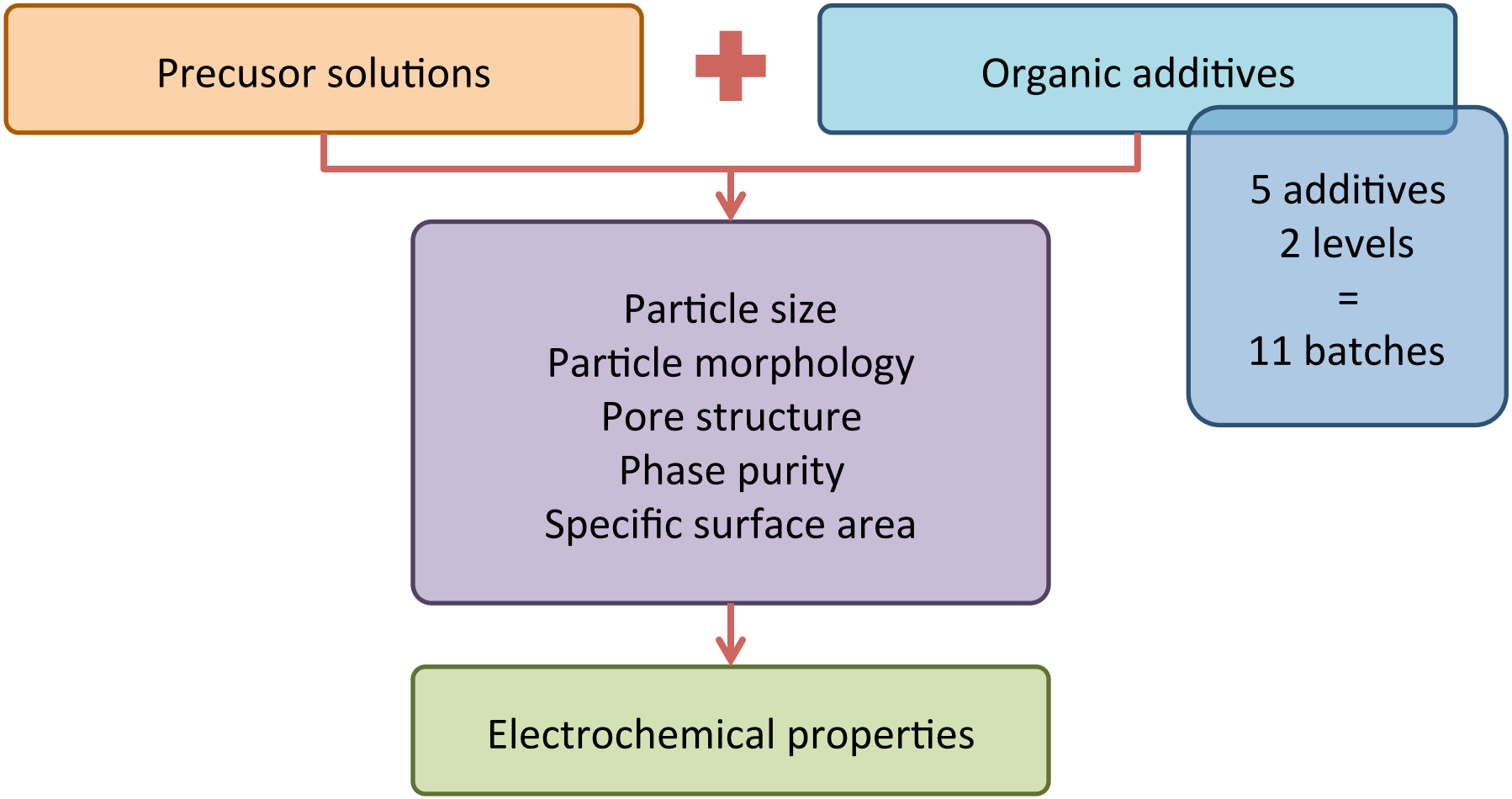
Case study: $La_{0.6}Ca_{0.4}CoO_3$

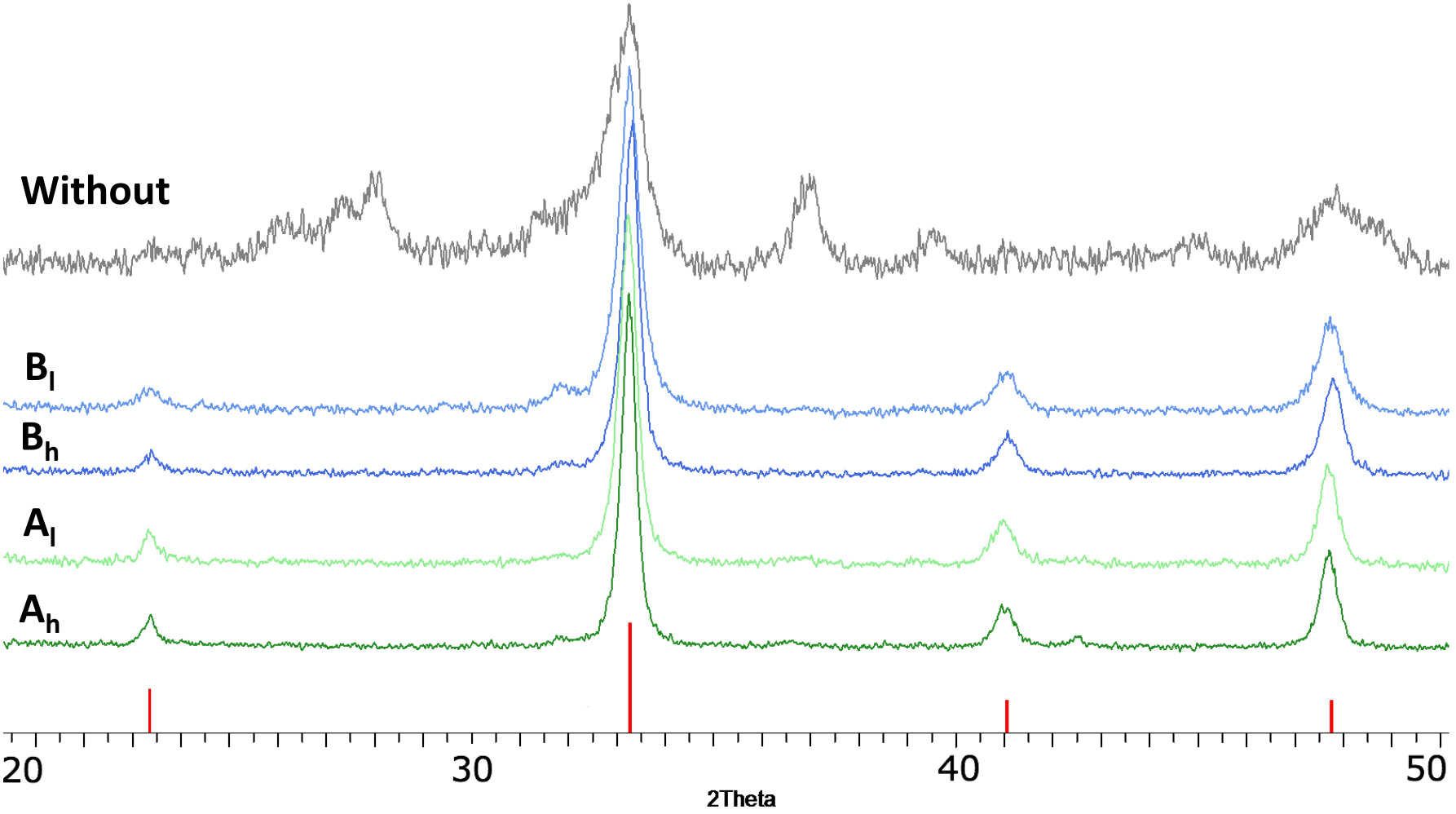
Tuning the material – Organic additives



Tuning the material – Organic additives



Phase composition



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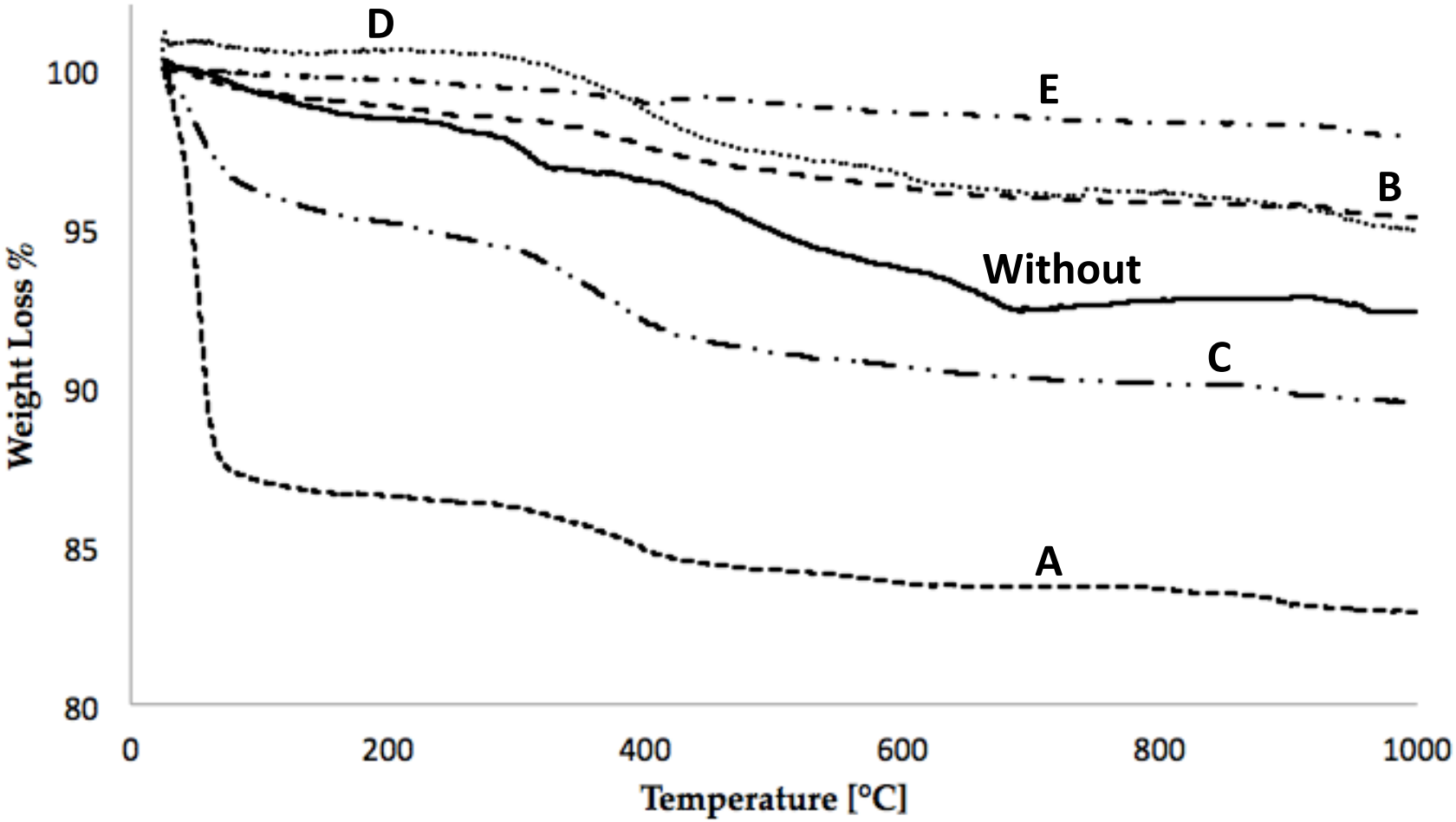
Thermogravimetry



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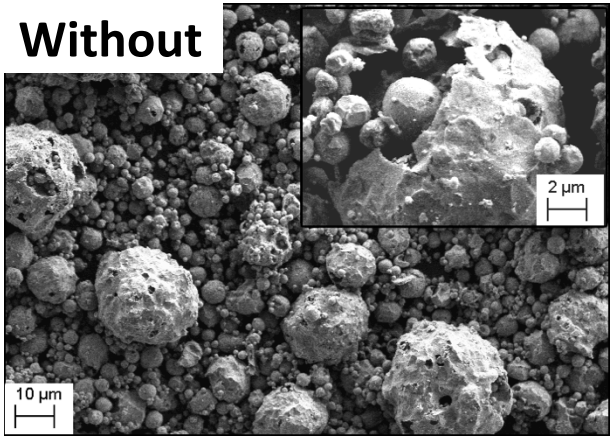
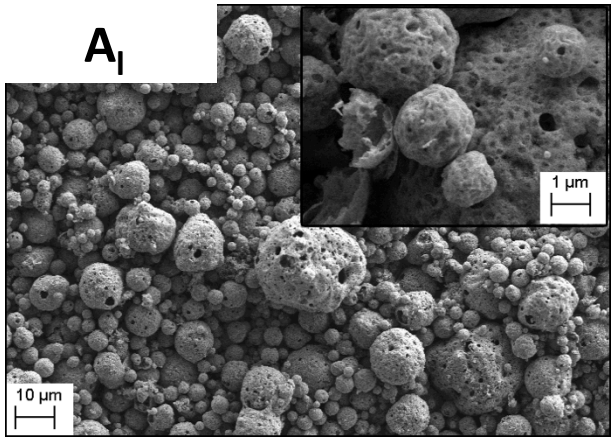
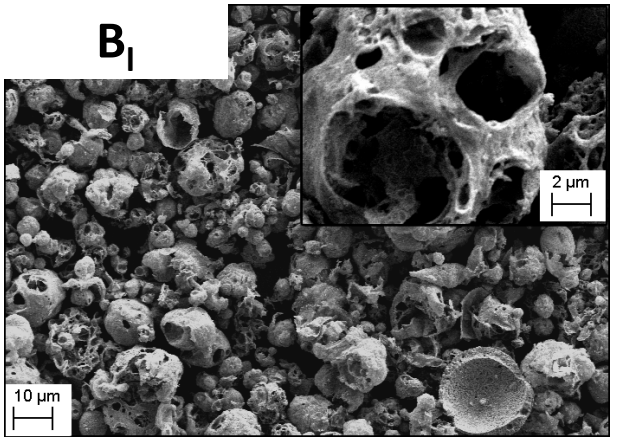
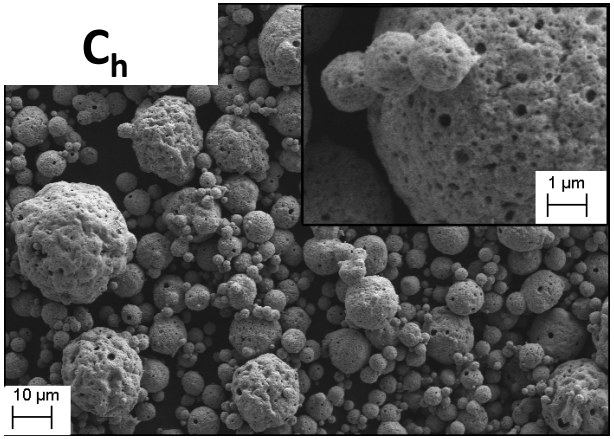
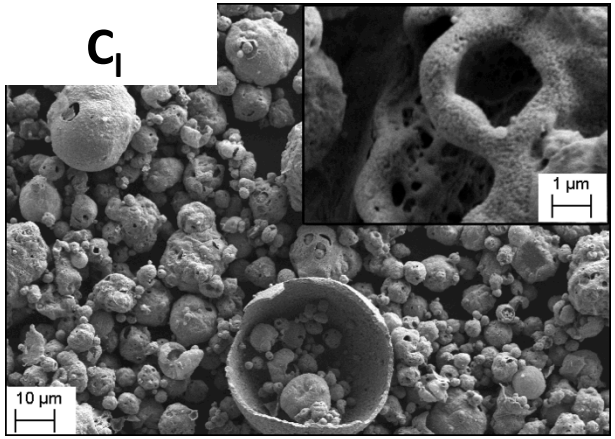
Particle morphology

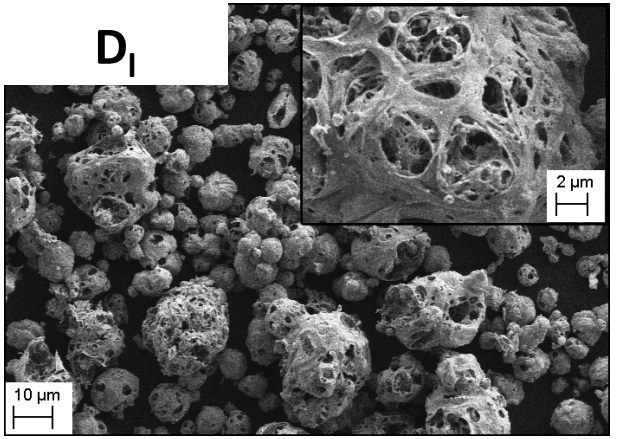












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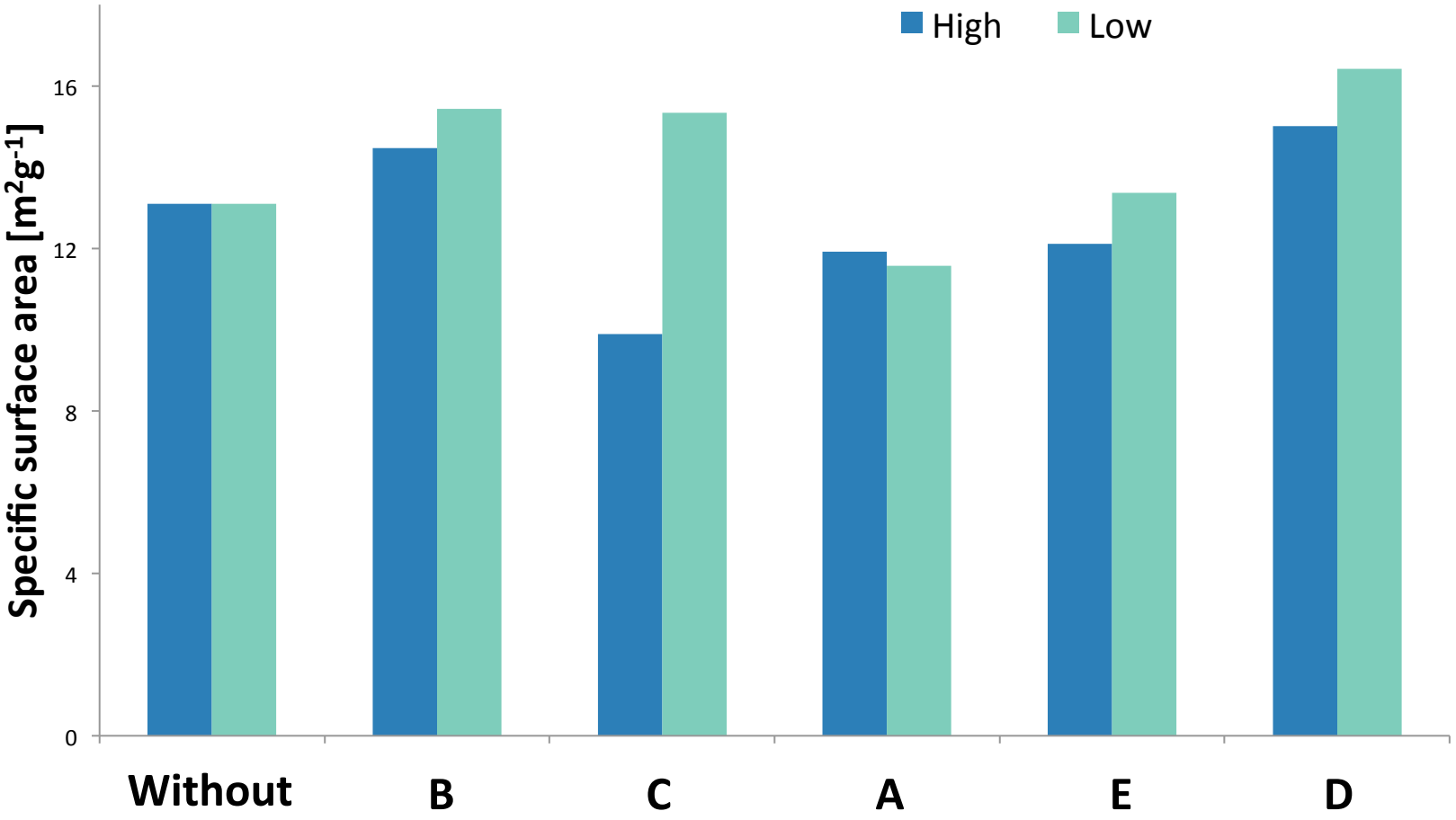
Specific Surface Area



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Concluding slides

Conclusion

- Spray pyrolysis is an effective method of producing a large variety of compositions
- We can tailor powder properties through careful choice of organic additives
- Calcination and milling can be optimised to meet quite narrow specifications
- Cerpotech is more than willing to assist you in developing the optimum powders for your needs

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Acknowledgements

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INNOVASJON NORGE
SEVENTH FRAMEWORK PROGRAMME
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Thank you for your attention!

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