THE Glatt POW(D)ER SYNTHESIS

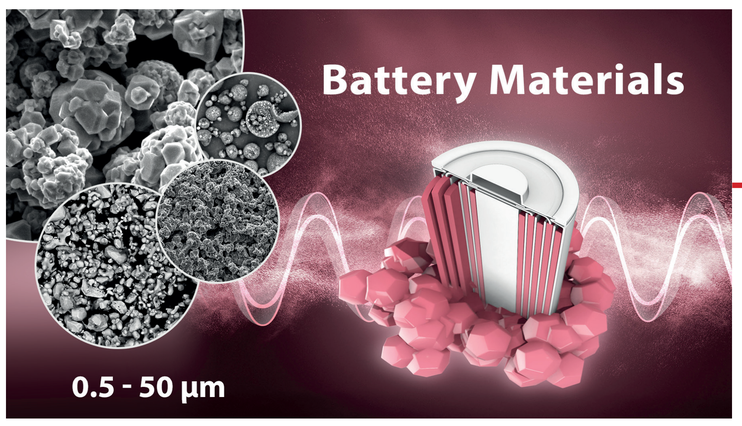
Aerosol-based processes to produce battery materials

Introduction

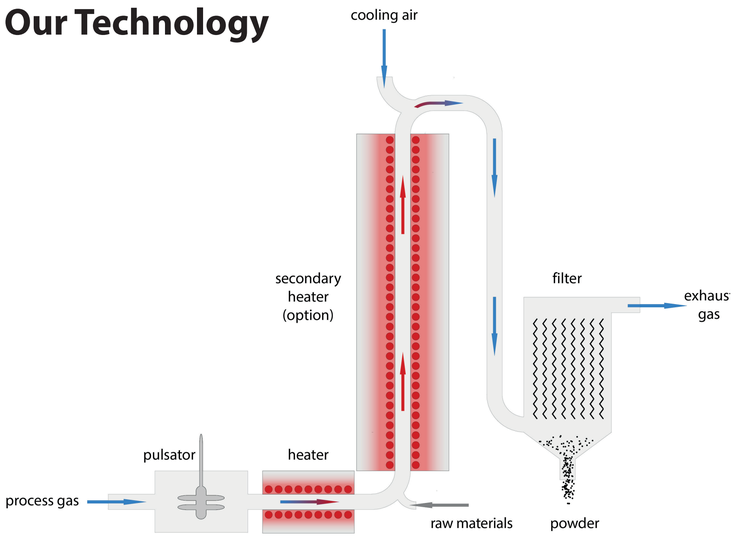
The development of active materials has undergone a continuous process with the aim of increasing energy density. This is being realised through the development of new, nickel-rich and cobalt-free cathode materials, the production of silicon-carbon composite materials and the development of solid-state batteries.

The increasing demand for applications within electromobility or stationary energy storage requires the implementation of innovative, sustainable and continuous manufacturing processes as well as processes for coating active materials. Aerosol-based methods based on spray drying/spray calcination and spray agglomeration are presented using selected examples.

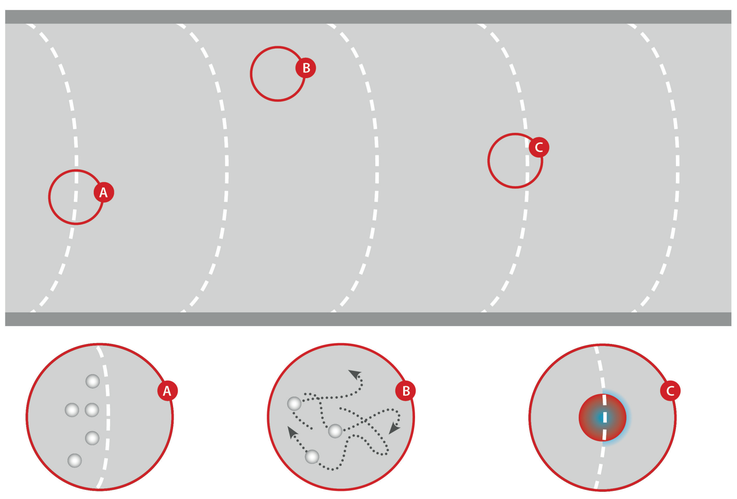
Overview of processes and material classes



Our Technology



Pulsation makes the difference!



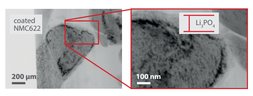
Impact of pulse will create superfine droplets by secondary atomization

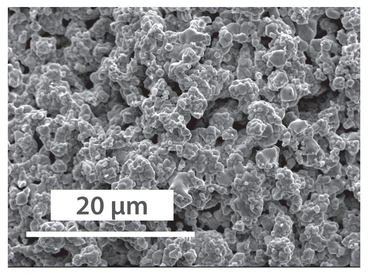
Pulsation creates a highly turbulent flow, homogenizing temperature and velocity in the gas stream and constantly changes the position of the particles to equalize the resident times

Impact of pulse and perpetual relative velocity between particle and gas stream will continuously break up boundary layers, guaranteeing high heat and mass transfer

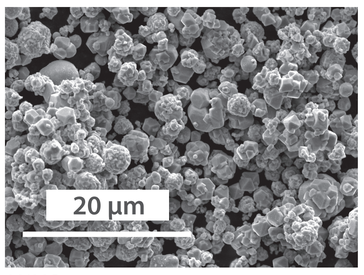
Preparation of active materials

- Step 1: Preparing (cathodic) active materials
- Step 2: Thermal refinement
- Step 3: Coating





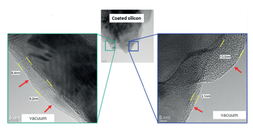
NMC622

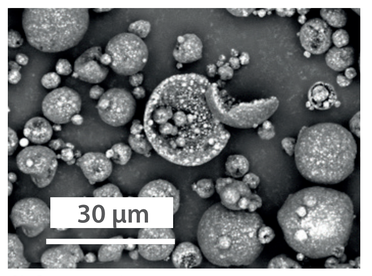


LNMO

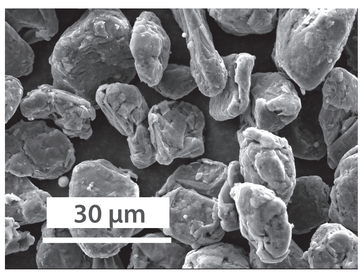
Examples of anodic active materials from different/flexible synthesis ways

- Silicon-based compounds
- Coated carbon-based compounds
- Conversion type / intercalation transition-metal compounds





Si-C-composite

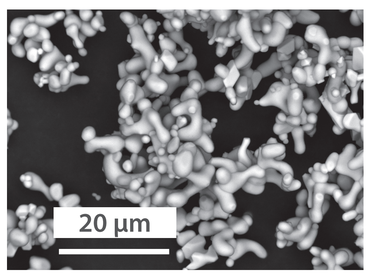


Coated graphite

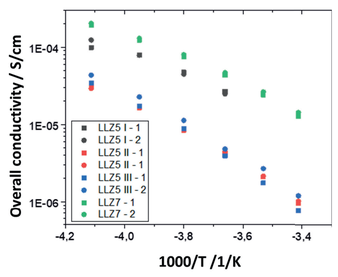
Preparation of solid electrolytes

- Step 1: Preparing and spraying solutions / suspensions
- Step 2: Thermal refinement
- Step 3: Additional functionalisation

Ceramic materials / composites



Al-doped LLZO



Advantages

- Adjustable particle size and narrow size-distribution from 50 nm - 50 µm
- Drying, coating and calcination in one step starting from solutions, suspensions or solids
- Superior product properties by innovative pulsating gas technology up to 1300 °C
- Flexible process variations like coating, synthesis, agglomeration and encapsulation
- Selectable reaction atmosphere: inert, oxidizing, reducing
- Unique structures and chemical compositions like doped and undoped complex oxides, mixed oxides like spinel or mullite, doped materials
- Innovative electrical heating; heat recovery
- Feasibility trials; process development; batch or continuous plants; contract manufacturing; scale-up

Johannes Buchheim and Thorben Vockenberg,
Glatt Ingenieurtechnik GmbH, Weimar

Further information can be found on our website
powdersynthesis.glatt.com

THE Glatt POW(D)ER SYNTHESIS

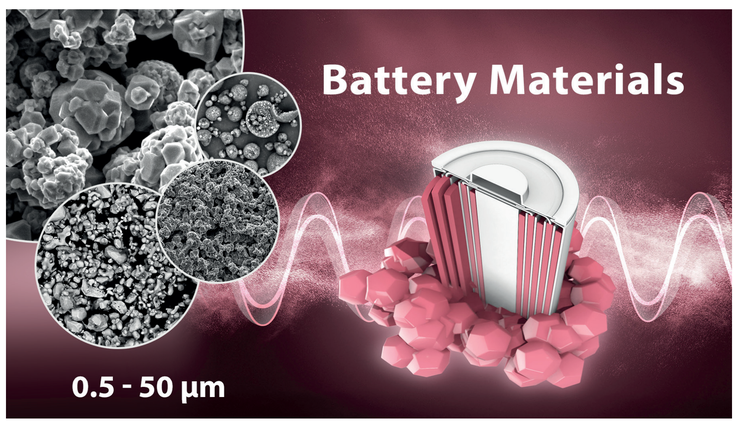
Aerosol-based processes to produce battery materials

Introduction

The development of active materials has undergone a continuous process with the aim of increasing energy density. This is being realised through the development of new, nickel-rich and cobalt-free cathode materials, the production of silicon-carbon composite materials and the development of solid-state batteries.

The increasing demand for applications within electromobility or stationary energy storage requires the implementation of innovative, sustainable and continuous manufacturing processes as well as processes for coating active materials. Aerosol-based methods based on spray drying/ spray calcination and spray agglomeration are presented using selected examples.

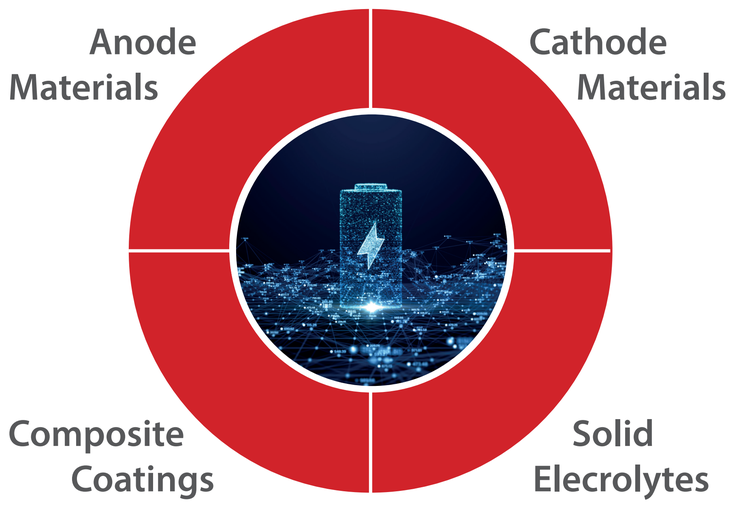
Overview of processes and material classes



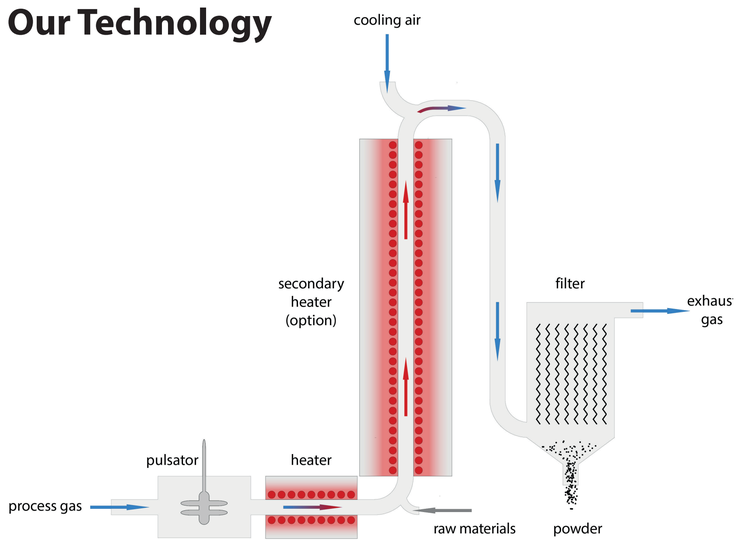
Cathode Materials

Synthesis

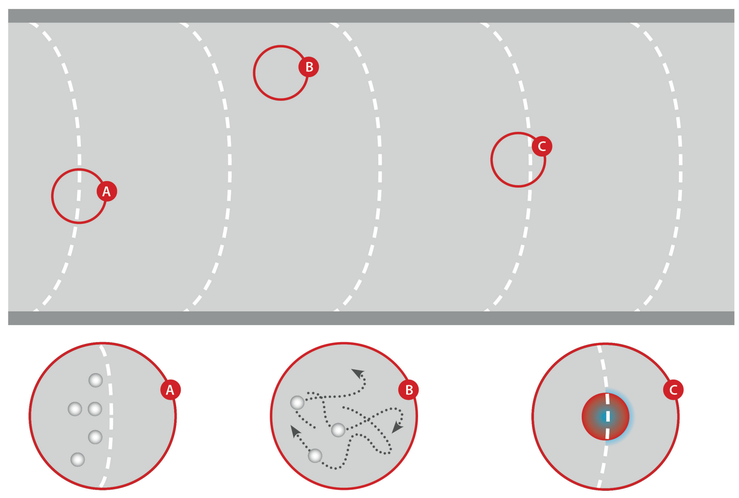
Core-Shell-Coating



Our Technology



Pulsation makes the difference!



Impact of pulse will create superfine droplets by secondary atomization

Pulsation creates a highly turbulent flow, homogenizing temperature and velocity in the gas stream and constantly changes the position of the particles to equalize the resident times

Impact of pulse and perpetual relative velocity between particle and gas stream will continuously break up boundary layers, guaranteeing high heat and mass transfer

Johannes Buchheim and Thorben Vockenberg,
Glatt Ingenieurtechnik GmbH, Weimar

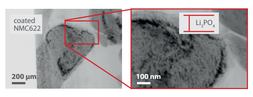
Further information can be found on our website
powdersynthesis.glatt.com

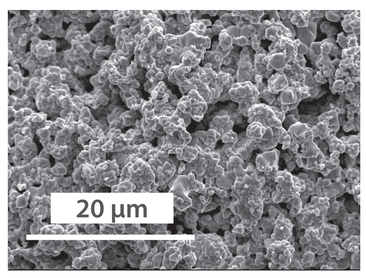
Preparation of cathodic active materials

Step 1 Prepararion of cathodic active materials

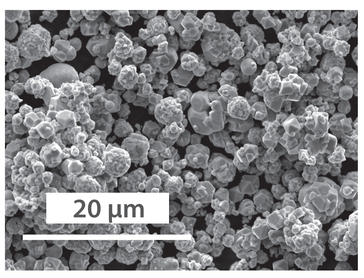
Step 2 Thermal refinement

Step 3 Coating





NMC622



LNMO

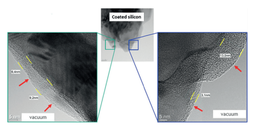
Examples: freely selectable stoichiometry like NMC-types, NCA, LNMO, LFP, LMFP, LMR/HE-NMC

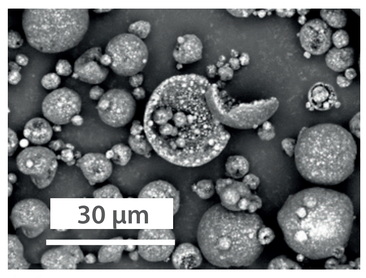
Preparation of anodic active materials

Step 1 Prepararion of cathodic active materials

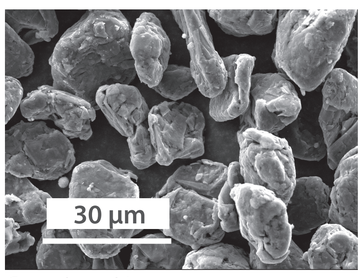
Step 2 Thermal refinement

Step 3 Coating





Si-C-composite



Coated graphite

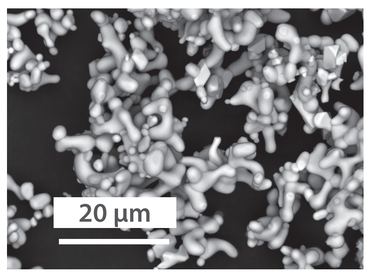
Examples: silicon-based compounds, coated carbon-based compounds, conversion type / intercalation transition-metal compounds

Preparation of ceramic materials and composites

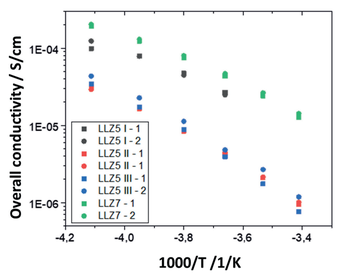
Step 1 Preparing and spaying solutions / suspensions

Step 2 Thermal refinement

Step 3 Additional functionalization



Al-doped LLZO



Examples: polymer-oxide-composites, oxide membranes + separators, functional materials to increase thermal stability of polymeric separators

Advantages

- Adjustable particle size and narrow size-distribution from 50 nm - 50 µm
- Drying, coating and calcination in one step starting from solutions, suspensions or solids
- Superior product properties by innovative pulsating gas technology up to 1300 °C
- Flexible process variations like coating, synthesis, agglomeration and encapsulation
- Selectable reaction atmosphere: inert, oxidizing, reducing
- Unique structures and chemical compositions like doped and undoped complex oxides, mixed oxides like spinel or mullite, doped materials
- Innovative electrical heating; heat recovery
- Feasibility trials; process development; batch or continuous plants; contract manufacturing; scale-up