

APPLICATIONS FOR

BATTERY TECHNOLOGY



BASIC MATERIALS



COMPONENTS



ASSEMBLY



RECYCLING

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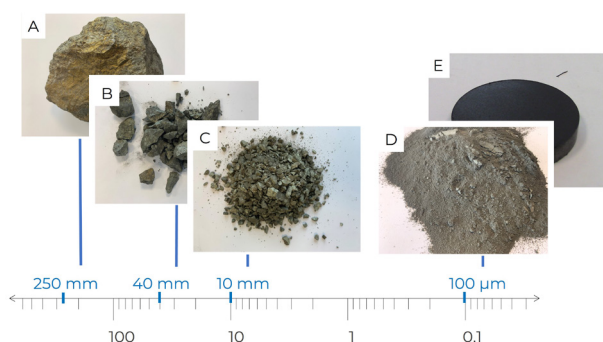
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SAMPLE PULVERIZATION

CRUSHERS AND MILLS TO PREPARE ORES FOR ANALYSIS

Only a few grams of sample are needed to analyze the concentration of valuable metals like lithium, manganese, or cobalt. The preparation of a representative sample for analysis may involve several steps: pre-crushing, fine-grinding, sample dividing and pellet pressing. RETSCH offers a wide range of crushers, mills, accessories and assisting devices to ensure reproducible sample homogenization for subsequent analysis.

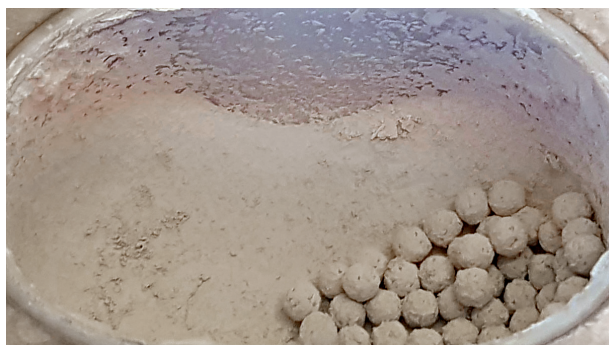


Sample preparation of copper ore: A: Original sample, B and C: sample pre-crushed in the Jaw Crusher BB 600 / BB200, D: sample pulverized in the Disc Mill RS 200 and E: sample divided with PT100 and pelletized using the Tablet Press PP35, for XRF analysis.

SAMPLE PULVERIZATION

LABORATORY BALL MILLS WITH TEMPERATURE CONTROL TO DEVELOP ALL-SOLID-STATE BATTERY COMPONENTS

The physical arrangement of active materials is one of the key characteristics of all-solid-state batteries. RETSCH's high energy laboratory ball mills are used to pulverize, mix and coat electrode materials on a laboratory scale. Ball mills with automatic temperature control are ideally suited, for example, to prepare specific particle size distributions of temperature-sensitive electrode materials, or to execute mechanochemical reactions under controlled temperatures and atmospheres. The MM 500 control allows to prepare battery materials at temperatures between -100 °C and + 100 °C.



Picture of a thiophosphate powder with 3 mm grinding balls in a 125 ml Screw-Lock jar. The sample was pulverized in the MM 500 control at -100 °C under inert atmosphere; the jar was opened in a glove box.



JAW CRUSHER BB 200

SHORT FACTS

- | Sample preparation of battery raw materials for analysis
- | Pre-crushing, fine grinding, sample dividing and pellet pressing

FIELD OF USE

- | Quality Control

Retsch



**MIXER MILL
MM 500 control**

SHORT FACTS

- | Pulverizing, mixing and coating of battery active materials
- | Material development for all-solid-state-batteries
- | Temperature controlled grinding

FIELD OF USE

- | Research

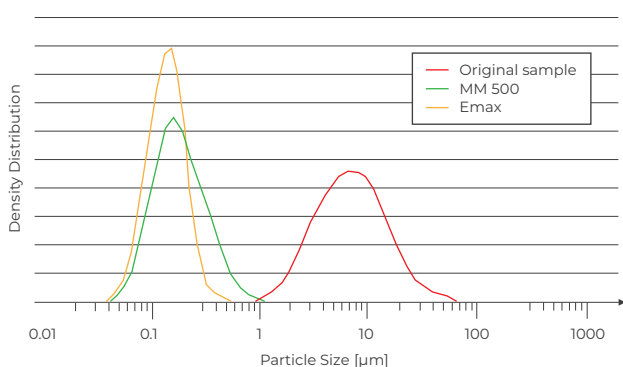
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SAMPLE PULVERIZATION

BALL MILLING TO PULVERIZE AND MIX ELECTRODE MATERIAL

RETSCH ball mills are used to pulverize and mix battery active materials on a laboratory scale. A typical area of application is the preparation of powders and slurries of electrode materials. The grinding, coating and mixing process can be carried out in planetary ball mills and mixer mills. High energy laboratory ball mills such as the MM 500 nano or Emax pulverize particles down to nanometer size.

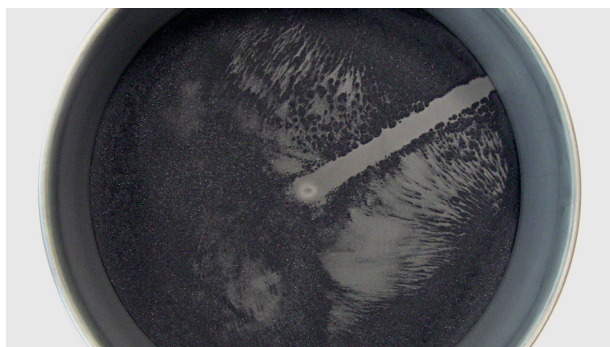


Particle size distribution of silicon powder obtained by wet grinding with the Mixer Mill MM 500 nano using zirconium oxide grinding tools (green curve) and with the Emax (yellow curve) for comparison. Measurement performed with Microtrac SYNC analyzer.

SIEVE ANALYSIS

PARTICLE SIZE ANALYSIS OF BATTERY MATERIALS BY SIEVING

For quality control of electrode materials RETSCH sieve shakers are used to characterize the particle size distribution. The portfolio includes shakers for various sieve diameters based on different movement patterns, with sieve apertures ranging from 10 µm to 125 mm. The Air Jet Sieving Machine AS 200 jet is particularly suitable for sieving fine powders, like graphite, which tend to agglomerate. To divide the sample into representative fractions before sieving, the sample divider PT 100 is used.



Sample remainder on a 20 µm sieve after sieving fine graphite powder with particle sizes < 300 µm. Sieving was performed with the "Swiss method", using the Sample Divider PT 100 and the Air Jet Sieving Machine AS 200 jet.



HIGH ENERGY BALL MILL EMAX

SHORT FACTS

- | High energy laboratory ball mills for grinding of battery active materials
- | Pulverization down to nanometer scale

FIELD OF USE

- | Research & Quality Control

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AIR JET SIEVING MACHINE AS 200 JET

SHORT FACTS

- | Sieving machines for particle size analysis
- | Sieve shakers with various movement patterns and different sieve diameters
- | Sample divider for representative division of bulk materials

FIELD OF USE

- | Research

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MILLING & SIEVING

SHREDDING AND SIEVING OF BATTERY MATERIAL FOR SEGREGATION

In the recycling process, shredding of dismantled or complete batteries is one of the initial steps. RETSCH cutting mills are used to shred batteries or components on a laboratory scale which helps researchers to develop new recycling routes. RETSCH sieving machines are employed to separate the different material fractions, for example black mass from polymeric and metallic parts.



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Left: Shredded LIB pouch cells. The cells are processed with the SM 300 on a laboratory scale. Right: Recycling fractions of LIB pouch cell. Sieving is one method to separate the black mass from the metallic and polymeric foils.



CUTTING MILL SM 300

SHORT FACTS

- | Development of new recycling routes
- | Powerful cutting devices with variable speed
- | Sieving machines for sieve diameters up to 450 mm

FIELD OF USE

- | Research & Quality Control

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MILLING & SIEVING

LABORATORY MILLS TO HOMOGENIZE BATTERY RECYCLING FRACTIONS

In a battery recycling process, the exhausted batteries are assorted in different material fractions. To evaluate the efficiency of a recycling process and to investigate the purity of each fraction, samples are homogenized and analyzed. The market value of the black mass, for example, depends on its content of valuable metals, like lithium or cobalt. Black mass can be homogenized in a ball mill. To avoid cross contamination, metallic or ceramic grinding tools should be chosen, respectively. The polymeric material fraction and metallic foils are first pre-cut with a cutting mill and then pulverized, usually at cryogenic temperatures, for example with RETSCH's CryoMill.



CRYOMILL

Housing parts

SM 300
60 mm / < 4 mm



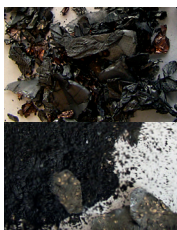
Polymeric-foil

CryoMill
10 mm / < 800 µm



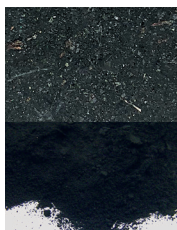
Metal foil

MM 500 control
15 mm / < 800 µm



Black mass

MM 400
2 mm / < 300 µm



Various material fractions of a recycling process, before and after homogenization for subsequent analysis to determine purity and market value.

SHORT FACTS

- | Sample preparation to analyze the chemical composition of recycling fractions
- | Laboratory ball mills for the homogenization of brittle and tough recycling fractions, like black mass, polymers or metallic foils

FIELD OF USE

- | Research & Quality Control

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