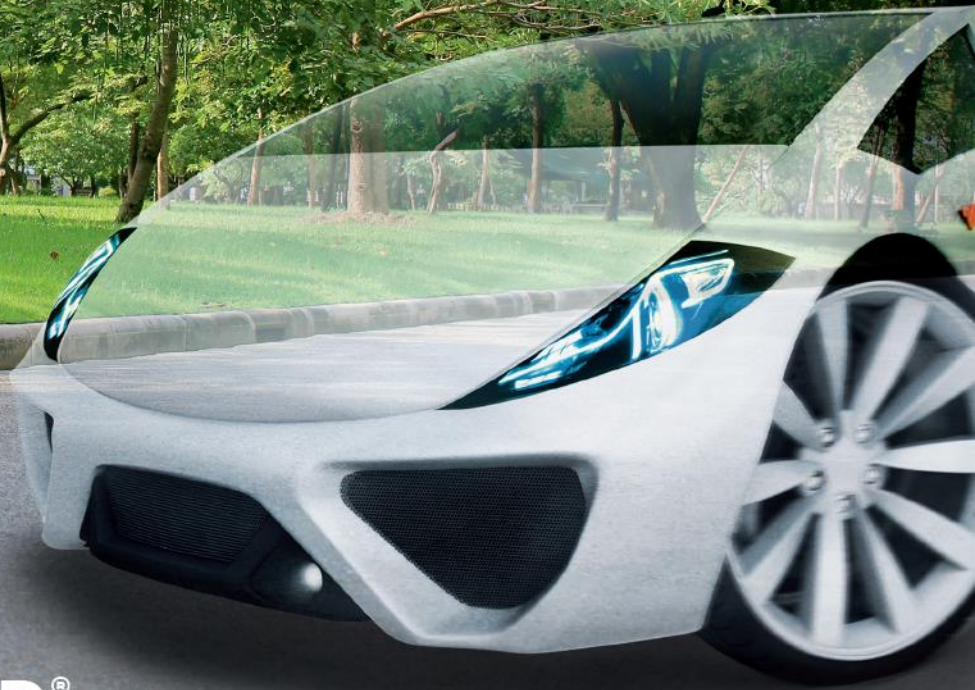




HUBER | MARTINSWERK



MARTOXID®

Specialty Aluminas for
Battery Separators



reducing CO₂ emissions

Advancing sustainable Innovation

Huber's innovative and cost effective solutions for lithium-ion battery separators (LIBS)



Electrification will be a key enabler for reducing CO₂ emissions for businesses, industries, customers and society at large, enabling fossil fuels to be replaced by renewable and climate neutral energy. Transportation accounts for roughly one third of the world's energy consumption. This makes the transportation sector central to the realization of a more sustainable energy system.

E-mobility will play a key role in solving many of the challenges we face today with regards to energy use and urbanization and a number of trends are expected to accelerate e-mobility:

- Lower costs from technology improvements
- Battery prices have decreased by about 80 percent since 2010
- Shifting consumer demand towards electric vehicles
- Increased urbanization
- Accelerated regulatory forces with stricter emissions and fuel-economy targets

Due to high energy density, long lifetimes, and projected economical costs, lithium ion battery technology has emerged as the platform of choice for the shift to electric vehicles. Within the value chain for lithium ion batteries, separators play a critical role in battery performance and safety.

Battery separators are permeable membranes which allow a controlled amount of current to pass from the anode to the cathode. As demand for higher performing batteries continues to grow, these polymer membranes are subject to increasing temperatures and stress. This can lead to reduced lifetimes and battery failures, which in turn present significant safety risks in operating e-vehicles.

To improve safety and performance, ultra thin ceramic coating technology is increasingly being applied to the polymer membrane to enhance resistance to thermal deformation and improve mechanical strength. The aim is to prevent short-circuits inside lithium-ion batteries and to ensure battery safety.

As a leading manufacturer of Specialty Aluminas, Huber's R&D Group has developed different technologies for the ceramic coating of LIB separators.

Through proprietary, highly quality controlled production and milling processes, we are able to keep metal impurities in our alumina at very low levels and tightly control particle size and particle size distribution, which is critically important in this application.

Overview of customer benefits and value

MARTOXID®

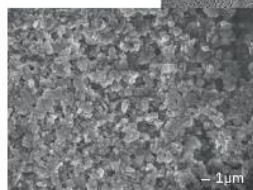
Alumina product characteristics

- Very low magnetic ion impurity levels
- Very low soda levels
- Very fine particle size with a uniform, narrow particle size distribution (d50 between 0,3–0,5 µm and d95 < 2 µm)
- Low surface area in relation to the very fine particle size
- Low water pick-up

Customer benefits and value

- High and stable product quality
- Cost effective solutions
- Excellent electrical properties to maximize Battery Life & Safety
- Consistent, reliable performance

→
Uncoated PE
separator with
20 µm thickness



A ceramic coated version with Huber's super ground alumina with 3 µm thickness

The coated separator was produced via wet coating process using doctor blade method with PvdF-co-HFP as a polymeric binder and N-methyl pyrrolidone as a solvent.

Physical properties MARTOXID® S 100

Typical analysis	unit	values
Specific surface area (BET)	m²/g	7,8
Particle size distribution (Beckmann Coulter)*	d ₁₀	µm 0,2
	d ₅₀	µm 0,4
	d ₉₀	µm 1,4
	d ₉₅	µm 1,6
Moisture (@ 105 °C)	%	< 0,2
Loss on ignition (@ 105 - 1000 °C)	%	< 0,5
XRF (semi-quantitive)	Al ₂ O ₃ ¹⁾	% 99,8
	Si ₂ O	% 0,08
	Na ₂ O	% 0,06
	Fe ₂ O ₃	% 0,02
	CaO	% 0,02
ICP	Cu	ppm < 10
	Ni	ppm < 10
	Zn	ppm < 10
	Cr	ppm < 10
Magnetic impurities**	ppm	< 1

* PSD values depend on measurement method and sample preparation

** Internal method

¹⁾ from total inorganic



Other Solutions

MARTOXID® aluminas for ceramic coatings in lithium-ion batteries, Huber offers also MARTINAL® ultra fine particle size aluminum hydroxides for this application. Please contact us in case you would like to receive further information.

To meet the demanding requirements of polymeric-related applications, Huber has introduced a series of thermally conductive powders for modified polymeric systems. MARTOXID® TM heat conductive alumina based fillers are easy-to-use and designed to improve the coexistence between fillers and matrix in thermally sensitive applications. They allow very high loading levels up to 90% necessary to effectively transfer heat away from electronic parts and provide excellent properties appropriate for thermal management of polymeric and resin compounds.

Our global footprint

Huber's Fire Retardant Additives (FRA) SBU is a specialty chemicals business with a global, leading position in the development and production of halogen-free fire retardant solutions, smoke suppressants and Specialty aluminas touching lives and enhancing safety for millions of people around the world.

North America

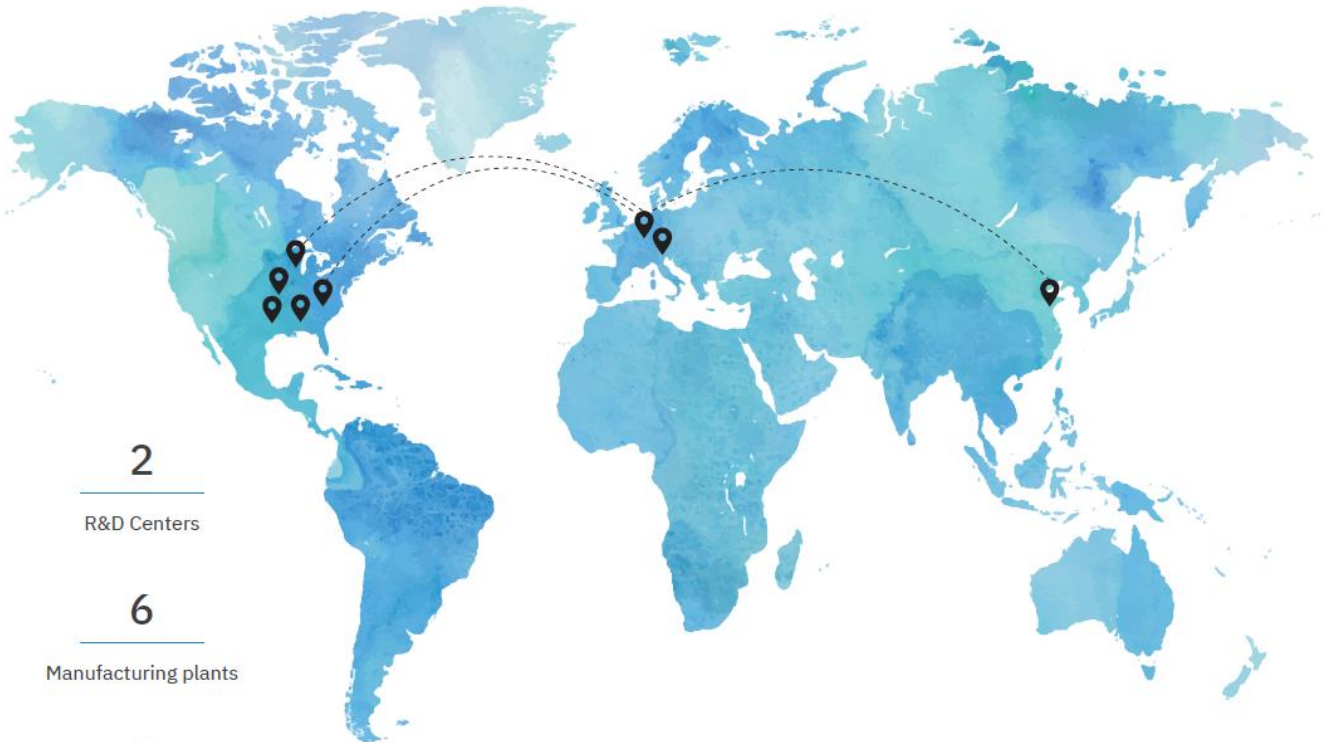
Fairmount, GA
Atlanta, GA
Kennesaw, GA
Marblehead, IL
Bauxite, AR

Europe

Bergheim, Germany
Breitenau, Austria

Asia

Qingdao, China



2

R&D Centers

6

Manufacturing plants

3

Customer Care
Centers

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