



IMERYS



MATERIAL SOLUTIONS FOR

THERMAL & ELECTRICAL INSULATION

ADVANCED CERAMICS

ENGINEERING THE FUTURE
WITH SUSTAINABLE SOLUTIONS.



INTRODUCTION AND APPLICATIONS

Certain electrical and thermal insulation properties are required and need tailoring in vast applications. Our raw materials are used in:

- **ceramic micro-circuits / substrates** for electronic components,
- **ceramic filled polymer matrices** such as gap fillers, thermal insulation pad etc. for electronic devices,
- **epoxy moulding compounds** for semiconductor chips or electronic components,
- **high voltage relays, switches etc.** for power infrastructure and power circuits and
- **spark plugs** for automotive applications.

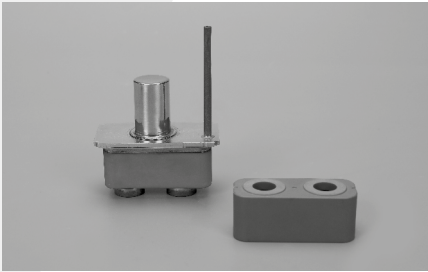
Dealing with flexural strength, fracture toughness, thermal expansion, thermal conductivity, dielectric properties or looking at processing characteristics is part of our work. For developments the utilisation of our different processes and global assets are essential.

SPECIFIC APPLICATION EXAMPLES

Ceramic substrates and thermal interface materials (TIM) require the ability to understand ceramic processing as well as processing know-how and the behaviour of materials in polymer matrices. Those applications demand from Aluminas a wide range of crystal sizes, diverse soda contents and morphologies. Our calcined Alumina EVT grades can be well used in formulation for isostatic pressing, uniaxial pressing as well as in hot injection moulding, extrusion, slip casting and gelling for substrate thicknesses down to 0.2mm. This is illustrated in the following table:

| | EVT500 | EVT400s | EVT300s |
|--------------------|--------|---------|---------|
| Hot Injection | ✓ | ✓ | |
| Isostatic pressing | | ✓ | ✓ |
| Dry pressing | | ✓ | ✓ |
| Extrusion | | | ✓ |
| Slip casting | | | ✓ |

Looking at **high voltage components** such as bushing insulators, fuses & arrestors, circuit breakers with switchgears and cabinets, Calcined Alumina EVTs and ALODUR Aluminas are the most popular raw materials. They are chosen due to their high voltage resistance, high mechanical strength and relatively low cost. For high voltage switches (e.g. SF6 interrupter) alumina is used as filler. Different high voltage components require, due to their shaping processes, different crystal sizes. Those components and also fillers demand as far as possible large primary crystal and spherical alumina. We address essentially almost all matters to support our customers' need to increase the strength while maintaining toughness on top of being able to meet commercial requirements in this price-driven segment.



High voltage relays



Another example to the **wider field of electronics** is the application of Epoxy Moulding Compounds (EMC). **EMCs show a great synergy with thermal interface materials where spherical shapes** show advantages such as a higher filling load and therefore also allow miniaturisation.

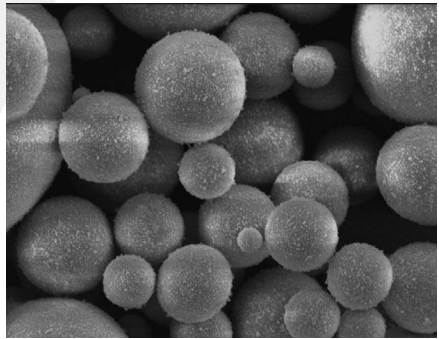
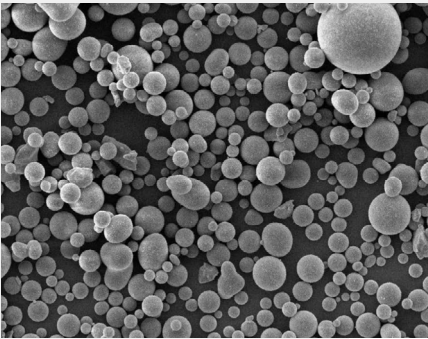
There is a great variety of raw material characteristics and this brochure should give you a first taste. We'd like to explore & utilise our technologies and materials together with our customers.



OUR OFFER

Our raw materials for those applications are **mainly supplied from our plants in China, Germany and the USA**. They are fused & crushed as well as calcined powders and some made via a chemical process. Natural minerals are also supplied into electrical isolation applications. Due to our various processes we can cover a wide range of particle sizes from sub μ level (for zirconia) to hundreds of μ m (for alumina and silica) and address also their shape, such as spherical morphology for silica.

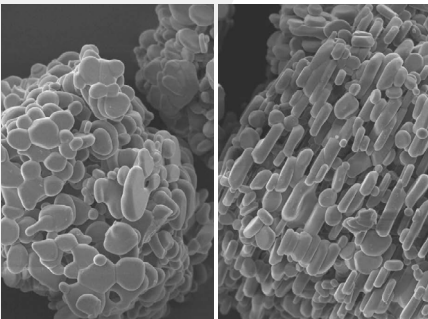
In fact the **TECO-SIL and TECO-SPHERE products** feature an extremely low coefficient of thermal expansion, consistent chemistry and carefully controlled particle size distribution.



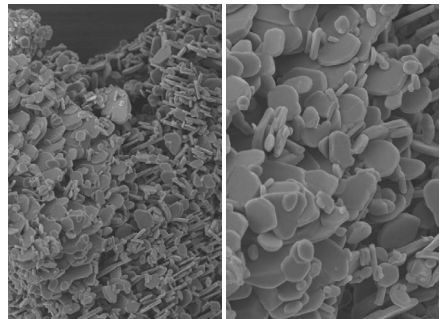
SEM pictures of TECO-SPHERE used in epoxy moulding compounds

In case of our **Calcined Alumina EVTs** they feature an overall high product consistency including carefully controlled particle size distributions.

EVT 500 / 400



EVT 300



SEM picture of Calcined Alumina EVTs

OUR TYPICAL PRODUCTS

| | | Calcined Al ₂ O ₃ |
|---------------------------|---|---|
| Applications | Low to high voltage components (e.g. switches, relays, vacuum tubes) | ☑ |
| | High voltage protection parts | ☑ |
| | Other high voltage components (e.g. spark plugs) | |
| | Ceramic substrates (thick film, HTCC, DCB,...) | ☑ |
| | Thermal Interface Materials | ☑ |
| | Epoxy Moulding Compounds | ☑ |
| Products | Product category | EVT |
| | Size category | 500 400 and 404 |
| Basic product information | Fused & crushed type | |
| | Spherical type | |
| | Other type (calcined, chemical,...) | ☑ |
| | Primary crystal size (for Al ₂ O ₃ s) or grain size (for others) | ~4.9µm ~4.0µm |
| | Typical soda content | ~0.06% |

Others: Talc, wollastonite, clays, alumino-silicates and graphite are used in various voltage components (incl. spark p

| ALODUR® | TECO® | ZIONIC™ | |
|---|---|---------------------------|--------------------------------------|
| Fused Al ₂ O ₃ | Fused SiO ₂ Spherical SiO ₂ | Chemical ZrO ₂ | YSZ |
| ☑ | | | |
| ☑ | ☑ | ☑ | |
| | | ☑ | ☑ |
| | | | |
| | ☑ | | |
| ZWSK | TECO-SIL TECO-SIL EMC TECO-SPHERE cyclone TECO-SPHERE micro | ZRO elec | 5% Y Zirconia HP 5% Y Zirconia HP |
| F800 F1000 F2000 others (F600...230) | -120F -200F -325F 44 i 74 i 74C 44C Others (A...micro) | 1.5-3µm 3-5µm | -1µm -2µm |
| ☑ | ☑ | ☑ | ☑ |
| | ☑ | | |
| | | ☑ | |
| ~6.5µm ~4.5µm ~1.2µm >9µm | 25-30µm 8-12µm 10-12µm 20-30µm 15-20µm 7-10µm <10µm | | |
| 0.1 - 0.2% 0.15 - 0.3% | | | |

plugs) and ceramic substrates

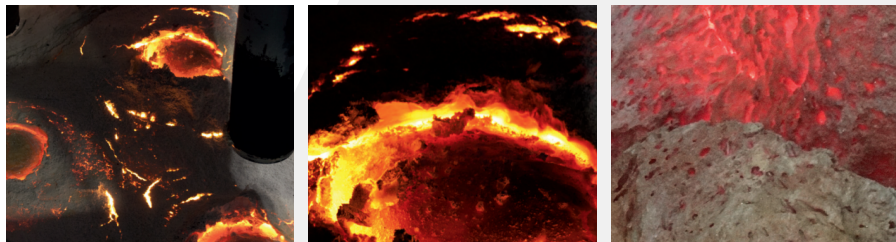
Production of calcined Alumina



Emission treatment at the calcined Alumina plant



Production of fused zirconia





THE WORLD'S LEADING PROVIDER OF MINERAL-BASED SPECIALTIES FOR INDUSTRY

Imerys offers high value-added solutions to many different industries, ranging from process manufacturing to consumer goods.

- We provide innovative and quality products to fit with our customers' needs
- We consider Safety as a priority
- We respect the world in which we operate



Over 15,000
customers



Sales in 142
countries



16,300
employees

At Imerys, we fulfill our role in society in a responsible way.

The technical expertise and innovative mindset of our people enable us to extract and transform minerals responsibly and in a sustainable way over the long term.

For further information, please contact :

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