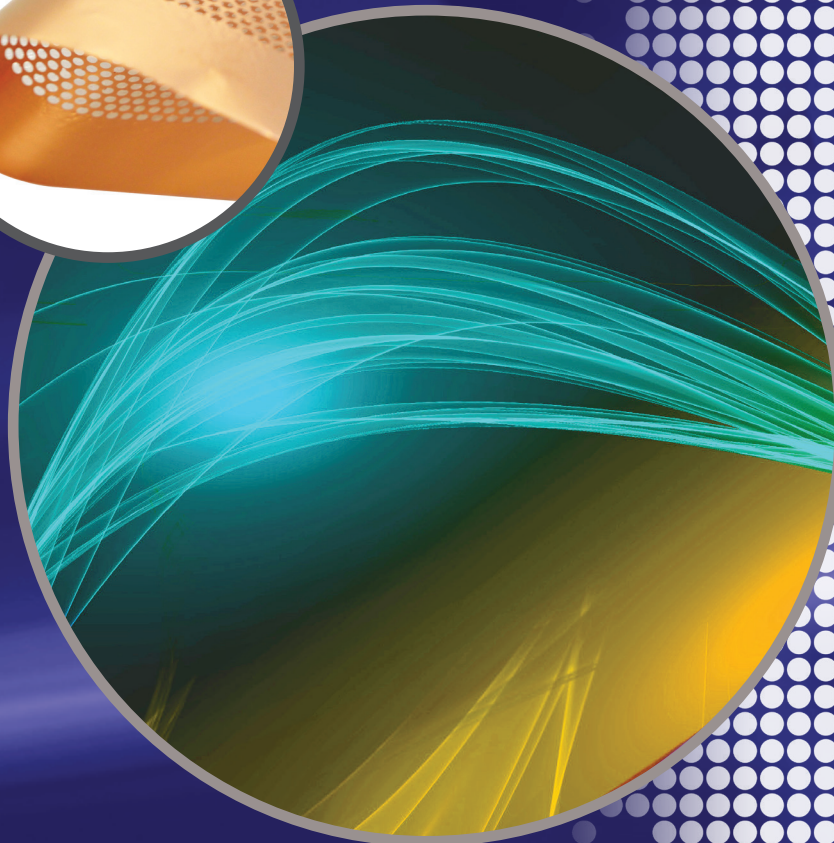
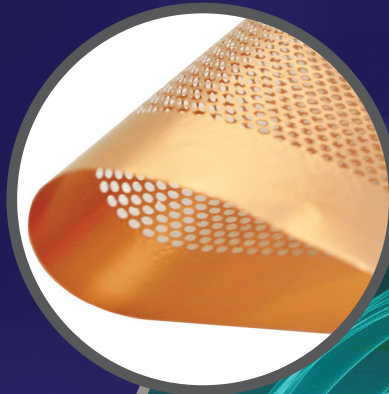


π PI-KEM

ENERGY RESEARCH



Product Catalogue

TURN YOUR THEORY INTO REALITY

We are specialist suppliers of advanced materials and equipment for innovative research, taking your ideas from lab-scale to production.

We custom manufacture to exact specifications, have expertise in sourcing niche products through our trusted network of worldwide suppliers and offer an on-line range of standard stock products including consumables available for immediate despatch.



Custom manufactured to your exact specifications



Expertise in sourcing niche products



Small to medium purchase quantities available



Over 1000 standard products stocked for immediate despatch



UK, Europe & Global delivery



Advice & support from an expert team of scientific Sales Executives

CONTENTS: Energy Research

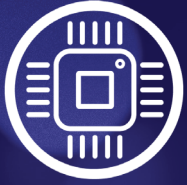


Battery & Supercapacitors (including Chemicals,
Materials, Cases & Consumables, Equipment)

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Solid Oxide Fuel Cells

Page 8-9



High Temperature Ceramic Adhesives, Coatings &
Sealants

Page 10-11

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Wafers (including Silicon Wafers)

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Substrate & Wafer Storage

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Ceramic Parts & Components

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Our Partners

We distribute on behalf of leading manufacturers of advanced materials & equipment



Battery & Supercapacitors: Chemicals



We supply a large selection of chemicals for battery and supercapacitor research in powder, granular and target forms. Below are our most requested lines, however we welcome any enquiry for other specifications.

LITHIUM CHEMICALS

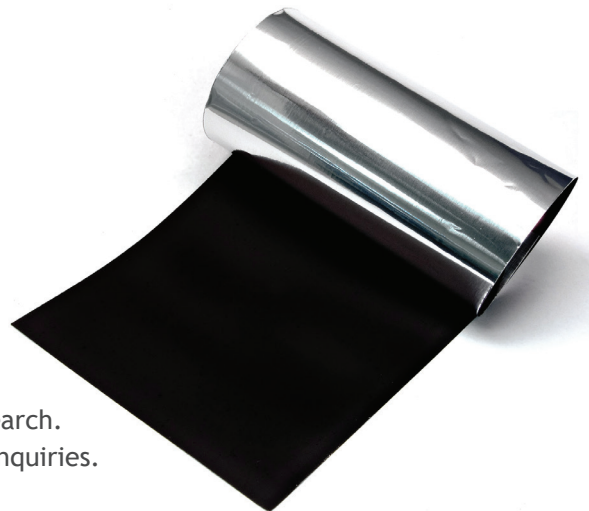
| Chemical Name | Formula |
|----------------------------------|---|
| Lithium Aluminium Cobalt Oxide | $\text{Li}_x\text{Al}_y\text{Co}_{1-y}\text{O}_2$ |
| Lithium Cobalt Oxide | LiCoO_2 |
| Lithium-Iron-Phosphate | LiFePO_4 |
| Lithium Lanthanum Titanium Oxide | LiLaTiO_3 |
| Lithium Manganese Dioxide | LiMnO_2 |
| Lithium Nickel Oxide | LiNiO_2 |
| Lithium Tantalate | LiTaO_3 |

| Chemical Name | Formula |
|--------------------------------|--|
| Lithium Titanate | Li_2TiO_3 |
| Lithium Titanium Oxide | $\text{Li}_4\text{Ti}_5\text{O}_{12}$ |
| Lithium Vanadium Phosphate | $\text{Li}_3\text{V}_2(\text{PO}_4)_3$ |
| Mixed Manganese Cobalt Dioxide | $\text{LiMn}_{1-y}\text{Co}_y\text{O}_2$ |
| Mixed Nickel-Cobalt Dioxide | $\text{LiNi}_{1-y}\text{Co}_y\text{O}_2$ |
| Mixed Nickel Manganese Dioxide | $\text{LiNi}_{1-y}\text{Mn}_y\text{O}_2$ |

SOLID STATE ELECTROLYTES

| Chemical Name | Formula |
|--|--|
| Lithium Aluminum Germanium Phosphate | $\text{LiAlGeP}_3\text{O}_{12}$ |
| Lithium Germanium Phosphorus Sulphide | LiGePS |
| Tantalum doped Lithium Lanthanum Zirconium Oxide | $\text{Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{Ta}_{0.25}\text{O}_{12}$ |
| Lithium Phosphorus Sulphide | Li_3PS_4 |
| Lithium Silicate | Li_2SiO_3 |
| Lithium Germanium Phosphorus Sulphide Chloride | $\text{Li}_{10}\text{GeP}_2\text{S}_{12}\text{Cl}$ |
| Lithium Phosphorus Sulphur Chloride | $\text{Li}_6\text{PS}_5\text{Cl}$ |
| Lithium Phosphorus Sulphur Bromide | $\text{Li}_6\text{PS}_5\text{Br}$ |
| Lithium Phosphorus Sulphur Iodide | $\text{Li}_6\text{PS}_5\text{I}$ |
| Lithium Phosphorus Tellurium Chloride | $\text{Li}_6\text{PTe}_5\text{Cl}$ |
| Lithium Phosphorus Tellurium Bromide | $\text{Li}_6\text{PTe}_5\text{Br}$ |
| Lithium Phosphorus Tellurium Iodide | $\text{Li}_6\text{PTe}_5\text{I}$ |
| Lithium Lanthanum Zirconium Tantalum Oxide | $\text{Li}_7\text{La}_3\text{Zr}_{2-x}\text{Ta}_x\text{O}_{12}$ |
| Aluminum doped Lithium Lanthanum Zirconium Oxide | $\text{Li}_{7-3x}\text{Al}_x\text{La}_3\text{Zr}_2\text{O}_{12}$ |
| Niobium doped Lithium Lanthanum Zirconium Oxide | $\text{Li}_{6.5}\text{La}_3\text{Zr}_{1.5}\text{Nb}_{0.5}\text{O}_{12}$ |
| Tantalum doped Lithium Lanthanum Zirconium Oxide | $\text{Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{Ta}_{0.25}\text{O}_{12}$ |
| Tungsten doped Lithium Lanthanum Zirconium Oxide | $\text{Li}_{6.3}\text{La}_3\text{Zr}_{1.65}\text{W}_{0.35}\text{O}_{12}$ |

Battery & Supercapacitors: Materials



We offer a wide range of materials for battery and supercapacitor research. Below are our most requested lines, however we welcome any other enquiries.

| | Product | Description |
|---|---|--|
|  | Custom coated electrode sheets (12.7 x 25.4cm) Custom coatings can be produced upon request. Active material loading, coating thickness and binder type can be modified to your requirements. | Anode Materials Cu foil, single side coated by: <ul style="list-style-type: none"> • $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (LTO) • Graphite • Activated Carbon Cathode Materials Al foil, single side coated by: <ul style="list-style-type: none"> • LiCoO_2 (LCO) • LiMn_2O_4 (LMO) • $\text{LiNi}_{0.8}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$ (NCA) • $\text{LiNi}_x\text{Mn}_y\text{Co}_z\text{O}_2$ (NMC) with ratio of NMC 111, 532, 622, 811 • LiFePO_4 (LFP) • $\text{LiMn}_{1.5}\text{Ni}_{0.5}\text{O}_4$ |
|  | Lithium Chips | <ul style="list-style-type: none"> • 15.6mm diameter x 0.25mm • 15.6mm diameter x 0.45mm |
|  | Metal Foils | <ul style="list-style-type: none"> • Aluminium (Al) • Carbon (C) • Copper (Cu) • Nickel (Ni) • Stainless Steel • Tantalum (Ta) • Titanium (Ti) • Tungsten (W) • Vanadium (V) • Zirconium (Zr) |
|  | Mesh | <ul style="list-style-type: none"> • Aluminium (Al) • Copper (Cu) |
|  | Foam | <ul style="list-style-type: none"> • Cobalt (Co) • Graphene • Nickel (Ni) • Silver (Ag) • Titanium (Ti) |

Battery & Supercapacitors: Cases & Consumables

We offer a wide range of cases and consumables for battery & supercapacitor research. Below are our most requested lines, however we welcome any enquiry for other specifications.



| | Product | Description |
|---|------------------|---|
|  | Coin Cells | <ul style="list-style-type: none"> • Coin/Button Cell Cases: CR2032, CR2025, CR2016, CR2450, CR1220, CR2325 • Wave Springs, Spacers, Belleville Washers • Kapton Cells for X-Ray analysis • Meshed Cells for Li-Air research • Gold, Platinum & Aluminium Coated options |
|  | Cylinder Cells | <ul style="list-style-type: none"> • Cylinder Cell Cases: 14500, CR123, 18650, 21700, 26650, 32650 • Tabs: Nickel & Aluminium in 3mm, 4mm & 8mm widths • Stainless Steel & Aluminium Cases available |
|  | Pouch Cells | <ul style="list-style-type: none"> • Aluminium Laminated Foils - Plane & Pre-formed Cases • Tabs: Nickel & Aluminium in 3mm, 4mm & 8mm widths • Custom Dies for cell forming • Hot Melt Sealing Adhesives in 4mm, 5mm, 8mm and 30mm widths |
|  | Split Test Cells | <ul style="list-style-type: none"> • Split Test Cells for Coin, Cylinder & Pouch Cells • 3-Electrode, Gold coated • Quartz & Beryllium window options for Raman/X-Ray analysis • 8-Channel Cell for high throughput testing |

Battery & Supercapacitors: Equipment

We provide an extensive choice of equipment for battery & supercapacitor research. Below are our most requested lines, however we welcome any enquiry for other specifications.



| | Product | Description |
|---|---------------------------------|---|
|  | Electrode Coating Preparation | <ul style="list-style-type: none"> • Tape Casters (Doctor Blade) with Vacuum Chuck; Heated Bed or Cover Heater Options • Roll-to-Roll Coaters • Rolling Presses (Calendars) • Dip Coaters |
|  | Button Cell Preparation | <ul style="list-style-type: none"> • Pneumatic, Hydraulic or Electric Coin Cell Crimping/Disassembling Machines • Dies to fit various cell sizes • Disk Cutters |
|  | Chemical Preparation / Analysis | <ul style="list-style-type: none"> • Tube & Vacuum Furnace • Rotary & High Pressure Furnace • Ball Mill & Mixer |
|  | Battery Testing Systems | <ul style="list-style-type: none"> • 5V - 50V, 1mA - 30A Battery Analyser with 1-8 Channels & Laptop Controlled |
|  | Sample Handling & Storage | <ul style="list-style-type: none"> • Glove Boxes & Vacuum Dry Ovens (1 to 4 chambers) • H₂O & O₂ Purification Systems • Vacuum Dry Ovens 25 - 360 Litres |
|  | Pouch Cell Preparation | <ul style="list-style-type: none"> • Pouch Cell Case Forming • Electrode Cutting / Slitting • Cell Core Stacking or Winding • Current Lead Welding • Vacuum Heat Sealers |

Solid Oxide Fuel Cell Technology

We offer a wide range of materials for solid oxide fuel cells.

Below are our most requested lines, however we welcome any enquiry for other specifications.

ANODE POWDERS

| Chemical | Standard Weight Percentage |
|----------|--|
| NiO/YSZ | <ul style="list-style-type: none"> • 50 wt% NiO / 50 wt% (8 mol% YSZ) • 60 wt% NiO / 40 wt% (8 mol% YSZ) • 70 wt% NiO / 30 wt% (8 mol% YSZ) • Custom NiO / YSZ |
| NiO/CGO | <ul style="list-style-type: none"> • 50 wt% NiO / 50 wt% Ce_{0.8}Gd_{0.2} Oxide • 60 wt% NiO / 40 wt% Ce_{0.8}Gd_{0.2} Oxide • 70 wt% NiO / 30 wt% Ce_{0.8}Gd_{0.2} Oxide • Custom NiO / CGO |

CATHODE POWDERS

| Chemical | Standard Weight Percentage |
|-------------------|---|
| La/Ca/Mn Oxide | <ul style="list-style-type: none"> • La_{0.8}Ca_{0.2}Mn Oxide • (La_{0.8}Ca_{0.2})_{0.98}Mn Oxide • Custom La/Ca/Mn Oxide |
| La/Co Oxide | <ul style="list-style-type: none"> • Custom La/Co Oxide |
| La/Sr/Fe Oxide | <ul style="list-style-type: none"> • La_{0.8}Sr_{0.2}Fe Oxide • Custom La/Sr/Fe Oxide |
| La/Sr/Fe/Co Oxide | <ul style="list-style-type: none"> • La_{0.6}Sr_{0.4}Fe_{0.2}Co_{0.8} Oxide • La_{0.6}Sr_{0.4}Fe_{0.8}Co_{0.2} Oxide • La_{0.8}Sr_{0.2}Fe_{0.8}Co_{0.2} Oxide • Custom La/Sr/Fe/Co Oxide |
| La/Sr/Mn Oxide | <ul style="list-style-type: none"> • La_{0.5}Sr_{0.5}Mn Oxide • La_{0.6}Sr_{0.4}Mn Oxide • La_{0.7}Sr_{0.3}Mn Oxide • La_{0.8}Sr_{0.2}Mn Oxide • (La_{0.8}Sr_{0.2})_{0.98}Mn Oxide • La_{0.85}Sr_{0.15}Mn Oxide • (La_{0.85}Sr_{0.15})_{0.98}Mn Oxide • La_{0.9}Sr_{0.1}Mn Oxide • Custom La/Sr/Mn Oxide |



INTERCONNECT POWDERS

| Chemical | Standard Weight Percentage |
|----------------|---|
| La/Ca/Cr Oxide | <ul style="list-style-type: none"> • La_{0.7}Ca_{0.3}Cr Oxide • La_{0.8}Ca_{0.2}Cr Oxide • Custom La/Ca/Cr Oxide |
| La/Sr/Cr Oxide | <ul style="list-style-type: none"> • La_{0.7}Sr_{0.3}Cr Oxide • La_{0.8}Sr_{0.2}Cr Oxide • Custom La/Sr/Cr Oxide |

ELECTROLYTES

| Chemical | Standard Weight Percentage |
|-------------------|--|
| Ce/Gd Oxide | <ul style="list-style-type: none"> • Ce_{0.8}Gd_{0.2} Oxide • Ce_{0.9}Gd_{0.1} Oxide • Custom Ce/Gd Oxide |
| Ce/Sm Oxide | <ul style="list-style-type: none"> • Ce_{0.8}Sm_{0.2} Oxide • Custom Ce/Sm Oxide |
| Ce/Y Oxide | <ul style="list-style-type: none"> • Ce_{0.8}Y_{0.2} Oxide • Custom Ce/Y Oxide |
| La/Sr/Ga/Mg Oxide | <ul style="list-style-type: none"> • La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.2} Oxide • La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2} Oxide • Custom La/Sr/Ga/Mg Oxide |
| ScSZr Oxide | <ul style="list-style-type: none"> • 10 mol% Sc₂O₃ / 90 mol% ZrO₂ • Custom ScSZr Oxide |
| YSZ Oxide | <ul style="list-style-type: none"> • 8 mol% Y₂O₃ / 92 mol% ZrO₂ • 10 mol% Y₂O₃ / 90 mol% ZrO₂ • Custom YSZ |

PROTONIC CONDUCTORS

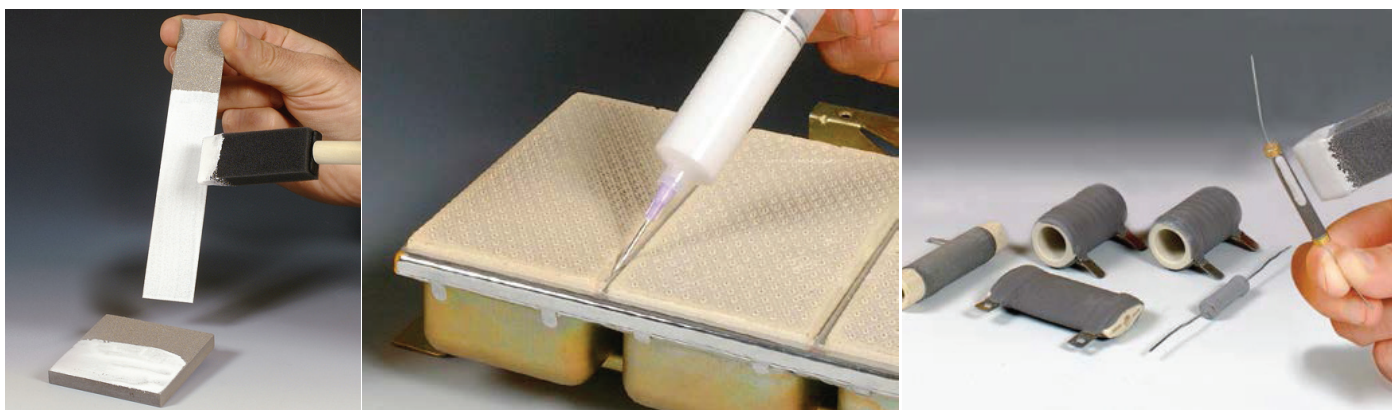
| Chemical |
|----------------------|
| Custom Ba/Ce/Y Oxide |
| Custom Ba/Zr/Y Oxide |

High Temperature Ceramic Adhesives, Coatings & Sealants

We supply a large selection of high temperature ceramic adhesives, coatings and sealants in partnership with Aremco.

Below are our most requested lines, however we welcome any enquiry for other specifications.

| AREMCO Product | Description |
|--|---|
| High Temperature Ceramic & Graphite Adhesives | Aremco's high temperature ceramic and graphite adhesives are unique formulations for bonding, potting and sealing ceramics, composites, graphite, metals, quartz and semiconductors for applications to 3200 °F (1760 °C). |
| High Temperature Coatings for Ceramics, Glass & Quartz | <p>Ceramic-Inorganic Single part, waterborne, silicon-filled, phosphate-bonded, brown-black coating for glass and quartz to 2000 °F (1093 °C). Primarily used for marking ceramic parts and coating automotive headlamps, stadium lighting and quartz vessels for the semiconductor industry. Standard viscosity is 200-400 cP; a higher viscosity coating, 845-HV, in the range of 500-800 cP is available upon request. Additional colours are offered in Jet Black, Cobalt Blue, Light-Gray, Light-Green, Dark-Green, Silver, White.</p> <p>Glass</p> <ul style="list-style-type: none"> • Glass-filled adhesive/sealer for use with porous ceramics & refractories up to 816 °C • Glass-ceramic filled, white reflective coating for glass & quartz to 816 °C |
| High Temperature Thermal Spray Sealants | <ul style="list-style-type: none"> • Single part, low viscosity, water-dispersed, aluminum phosphate solution for penetrating ultra fine thermal spray applications to 3000 °F (1650 °C) • Single part, alumina-filled, phosphate-bonded, abrasion and corrosion resistant sealer for thermal spray applications to 3000°F (1650 °C). Available in the following standard colours of White, Black, Blue, Red, Orange • Single part, urethane-based, gloss black, low viscosity, room temperature curing, abrasion and corrosion resistant sealer for applications to 400 °F (204 °C) • Two part, novolac-epoxy with exceptional abrasion and corrosion resistance for continuous operations to 300 °F (150 °C) and intermittent use to 400 °F (204 °C) • Single part, silicone-based, low viscosity, heat-curable, aluminum-filled sealer offering exceptional moisture resistance to 1100 °F (593 °C) |



| AREMCO Product | Description |
|---|--|
| <p>High Temperature Electrical Coatings & Sealants</p> | <p>Ceramic-Inorganic</p> <ul style="list-style-type: none"> • Viscous, off-white, electrical insulation paste for circuit breakers, power resistors and solenoids to 1316°C • Low viscosity, light gray, electrical insulation coating for high power resistors and rheostats to 1316°C. Black and green pigments also available <p>Silicone</p> <ul style="list-style-type: none"> • Transparent silicone sealer with exceptional electrical and moisture resistance to 427°C. High viscosity (HV) and very high viscosity (VHV) versions available <p>Silicone-Ceramic</p> <ul style="list-style-type: none"> • Translucent-white, low-viscosity sealer for porous materials to 482°C • Low viscosity, white, electrical insulation coating for motor windings to 593°C • Low viscosity, green, electrical insulation coating for power resistors to 593°C <p>Silicone-Glass</p> <ul style="list-style-type: none"> • Silicone-glass-ceramic, gray, low viscosity, scratch resistant coating 482°C • Silicone-glass-ceramic, gray, low viscosity, scratch resistant coating 760°C <p>Glass</p> <ul style="list-style-type: none"> • Glass-enamel, gloss-black coating for stainless steel to 538°C |
| <p>High Temperature High Emissivity Coatings</p> | <p>Aremco's HiE-Coat™ 840-Series line of high emissivity coatings are black-body formulations designed to significantly improve the thermal efficiency of infrared heaters, furnaces, incinerators, and ovens used throughout the appliance, ceramics, chemical processing, metallurgical and refining industries. Natural gas and oil savings in the range of 5-10% are typical using these coatings.</p> |
| <p>Ultra High Temperature Ceramic Coatings</p> | <p>Aremco's Corr-Paint™ CP3015-xx series coatings are silicate-bonded, ceramic and/or metal-filled, aqueous-based systems that provide excellent resistance to thermal shock, oxidation and chemical corrosion, with good colour stability for applications as high as 1500 °F (816 °C).</p> <p>These coatings are single-part, fast curing systems that adhere well to carbon and stainless steels, ceramics and refractories. Mainly recommended for interior system protection, several standard colours are provided and custom colours are available upon request.</p> |

Photovoltaic Chemicals

We provide an extensive choice of chemicals for photovoltaic research in target, granule and crucible form.

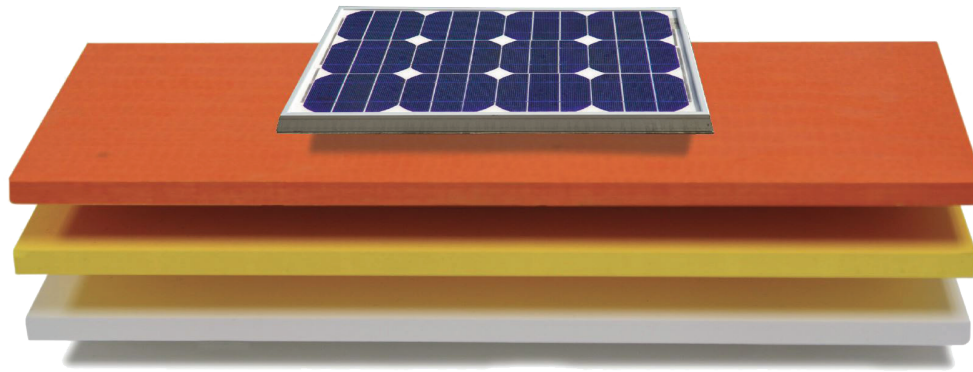
Below are our most requested lines, however we welcome any enquiry for other specifications.

TRANSPARENT CONDUCTING OXIDES (TCOS)

| Chemical Name | Formula |
|--------------------------------|--|
| Zinc Oxide | ZnO |
| Gallium Zinc Oxide | Ga ₂ O ₃ :ZnO |
| Indium Tin Zinc Oxide | In ₂ O ₃ :SnO ₂ :ZnO |
| Copper Gallium Sulphide | Cu ₂ GaS ₃ |
| Copper Indium Gallium Selenide | CuInGaSe |
| Cadmium Telluride | CdTe |
| Indium Zinc Oxide | In ₂ O ₃ :ZnO |
| Indium Gallium Tin Oxide | In ₂ O ₃ :Ga ₂ O ₃ :SnO ₂ |
| Zinc Aluminium Oxide | ZnO:Al ₂ O ₃ |
| Copper Selenide | Cu ₂ Se |
| Copper Indium Selenide | CuInSe ₂ |
| Cadmium Sulphide | CdS |
| Indium Gallium Zinc Oxide | In ₂ O ₃ :Ga ₂ O ₃ :ZnO |
| Indium Gallium Manganese Oxide | In ₂ O ₃ :Ga ₂ O ₃ :MnO ₃ |
| Zinc Tin Oxide | ZnO:SnO ₂ |
| Copper Sulphide | Cu ₂ S |
| Copper Indium Sulphide | CuInS ₂ |

CONVENTIONAL & CUSTOM SELENIDES, TELLURIDES & OTHER SALTS

| Chemical Name | Formula |
|----------------------------------|----------------------------------|
| Cadmium Arsenide | Cd ₃ As ₂ |
| Cadmium Oxide | CdO |
| Cadmium Oxide/Tin Oxide | CdO/SnO ₂ |
| Cadmium Selenide | CdSe |
| Copper Indium Gallium Diselenide | CIGS |
| Copper Indium Selenide | CIS |
| Copper Zinc Tin Sulphide | CuZnSnS |
| Copper Zinc Tin Selenide | CuZnSnSe |
| Gallium Arsenide | GaAs |
| Indium Phosphide | InP |
| Cadmium Stannate | Cd ₂ SnO ₄ |
| Cadmium Sulphide | CdS |
| Cadmium Telluride | CdTe |
| Cadmium Tungsten Oxide | CdWO ₄ |
| Cadmium Zinc Telluride | CZT |



ALLOY TARGETS

| Chemical Name | Formula |
|-----------------|---------|
| Indium Tin | In:Sn |
| Indium Antimony | In:Sb |
| Zinc Aluminium | Zn:Al |


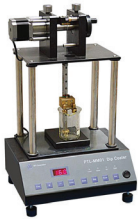

EVAPORATION GRANULES

| Chemical Name | Formula |
|---------------------------|---------|
| Copper Germanium | CuGe |
| Copper Germanium Selenium | CuGeSe |

STANDARD METALS & NON-METALS

Standard base metals and non-metals are available upon request

LABORATORY EQUIPMENT

| | Product | Description |
|---|-------------------------------|---|
|  | Spin Coaters | <ul style="list-style-type: none"> 7", 8", 12" & 15" Bowl Diameters Manual & programmable options Manual, Semi-Automatic & Automatic dispenser options Standard sizes & custom chuck designs Additions: Vacuum Pumps - Oiled or Oil-Free, Air Compressors & Hot Plates (50-350°C) up to 150mm Diameter |
|  | Dip Coaters | <ul style="list-style-type: none"> Up to 60cm x 45cm Manual & programmable options |
|  | Ovens & Hot Plates | <ul style="list-style-type: none"> Vacuum & Forced Air Convection models, available in desktop & free standing options up to 500°C Digital Controlled Hot Plates, available with stirrer options & sample mounting plates |

For related products:

- WAFERS** (inc. Silicon Wafers & Semi Conductor Wafers) Page 14-16

Silicon Wafers

We offer a wide range of silicon wafers, produced to exact customer requirements or as standard wafer specifications available from stock.

Below are our most requested lines, however we welcome any enquiry for other specifications.

Grades

| Prime | Test | Reclaim | Mechanical |
|-------|------|---------|------------|
|-------|------|---------|------------|

Diameter & Thickness

| Size | Standard Thickness (µm) | Tolerance (+/- µm) |
|-------------|-------------------------|--------------------|
| 1" (25.4mm) | 250 | 15 |
| 2" (50.8mm) | 275 | 25 |
| 3" (76.2mm) | 380 | 25 |
| 4" (100mm) | 525 | 20 |
| 5" (125mm) | 625 | 20 |
| 6" (150mm) | 675 | 20 |
| 8" (200mm) | 725 | 25 |

Specialist thin wafers available: 1" down to 10 µm thick / 4" down to 90 µm thick / 6" down to 150µm thick
Custom thicknesses available on request

Type & Dopant

| Type | Dopant |
|-----------|---|
| Intrinsic | - |
| n-type | P- Phosphorous, Sb - Antimony, As - Arsenic |
| p-type | B - Boron |

Heavy P or B doping is also available

Resistivity

| Crystal Growth Method | From | To |
|-----------------------|---------------|---------------------|
| Czochralski (CZ) | 1 milliohm-cm | 150 ohm-cm |
| Float Zone (FZ) | - | Up to 10,000 ohm-cm |

Orientation

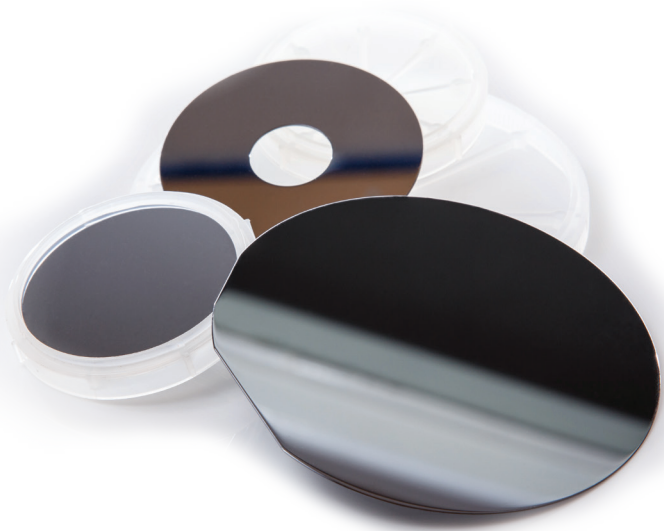
| Orientation | Tolerance |
|-------------|--|
| <100> | Standard +/- 0.5° & Custom up to +/- 0.05° |
| <110> | |
| <111> | |

Custom Orientations & Off Orientations (up to 40°) available on request

Surface

| As cut | Lapped | Etched | Single Side Polished | Double Side Polished |
|--------|--------|--------|----------------------|----------------------|
|--------|--------|--------|----------------------|----------------------|

On polished surface: Roughness <math><2\text{\AA}</math> / Total Thickness Variation (TTV) <math><1\mu\text{m}</math>
Laser marking available on request



Silicon as a Substrate

| Type | Specifications |
|------------|--|
| Windows | As per customer drawings |
| Components | As per customer drawings |
| Blocks | To customer specification including surface roughness & flatness |

We can also supply Germanium single crystal components

Platinised Wafers

| | Specifications |
|----------|---|
| Diameter | 4" Standard or other sizes available upon request |
| Layers | Thermal SiO ₂ , TiO ₂ or Ti Adhesion, Platinum E-Beam |

Silicon on Insulator (SOI) Wafers

| | Specifications |
|--------|---|
| Size | As per customer specification |
| Layers | Handle, Device, Buried Oxide (BOX) - All layers as per customer specification |

Services

Coatings

| Type | Method | Thickness (nm) | Diameter |
|---|-------------------------------------|----------------|---|
| SiO ₂ Silicon Dioxide | Wet Oxidation | 200-3000 | From 1" to 6" |
| | High Purity Dry Oxidation | 20-300 | From 1" to 6" |
| <i>Single face oxidation also available</i> | | | |
| Si ₃ N ₄ Silicon Nitride | LPCVD or PECVD | 20-500 | From 2" to 6" |
| Metal Coatings including: Cr, Ti, Au, Al, Pt, Mo, W, Ni, Cu, Ir, Ta | PVD Sputtering or Evaporation | 20-1000 | From 1" to 6" <i>(depending on metals)</i> |

Other metal coatings & multi-layer deposition available on request

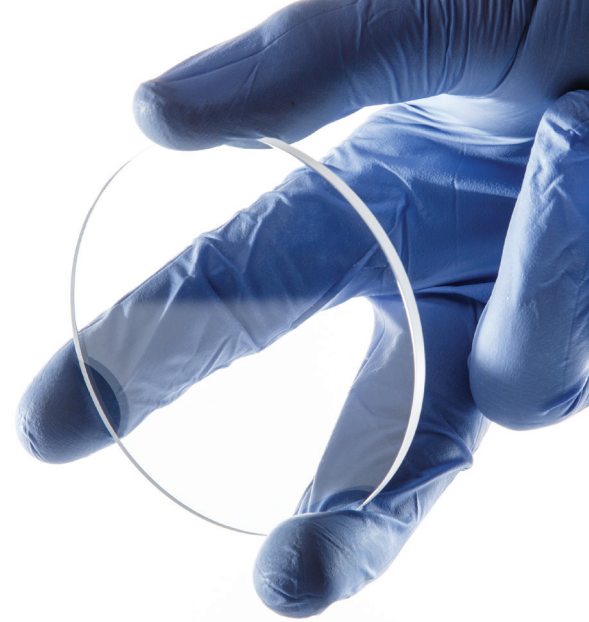
Dicing Services

| Form | Specifications |
|-------|---|
| Tiles | E.g. 10mm x 10mm, 20mm x 20mm <i>(minimum size 1.5mm x 1.5mm)</i> |

Wafers

We provide an extensive choice of wafers.

Below are our most requested lines, however we welcome any enquiry for other specifications.



GLASS WAFERS

The following specifications of Borofloat glass wafers are all available from stock for immediate despatch.

We also offer wafers and tiles to custom specifications, including diameter, thickness and polish.

| Material | Wafer Diameter | Thickness | Polish |
|----------------------|----------------|---------------------|-----------------------|
| Borofloat BF33 Glass | 2" (50.8mm) | 0.5mm \pm 0.025mm | Double Sided Polished |
| Borofloat BF33 Glass | 3" (76.2mm) | 0.5mm \pm 0.025mm | Double Sided Polished |
| Borofloat BF33 Glass | 4" (100mm) | 0.5mm \pm 0.025mm | Double Sided Polished |

SILICON CARBIDE WAFERS

The use of Silicon Carbide (SiC) in the semiconductor industry has expanded due to its advantageous physical properties, including its hardness, high thermal conductivity and low coefficient of thermal expansion.

At PI-KEM we offer a range of Silicon Carbide (SiC) wafers in a number of polytypes including both 4H and 6H SiC in a range of wafer diameters. Please contact us for further information.

SEMICONDUCTOR WAFERS

III-V Wafers

| Name | Formula |
|-------------------|---------|
| Gallium Arsenide | GaAs |
| Gallium Phosphide | Gap |
| Indium Phosphide | InP |
| Indium Antimonide | InSb |
| Indium Arsenide | InAs |

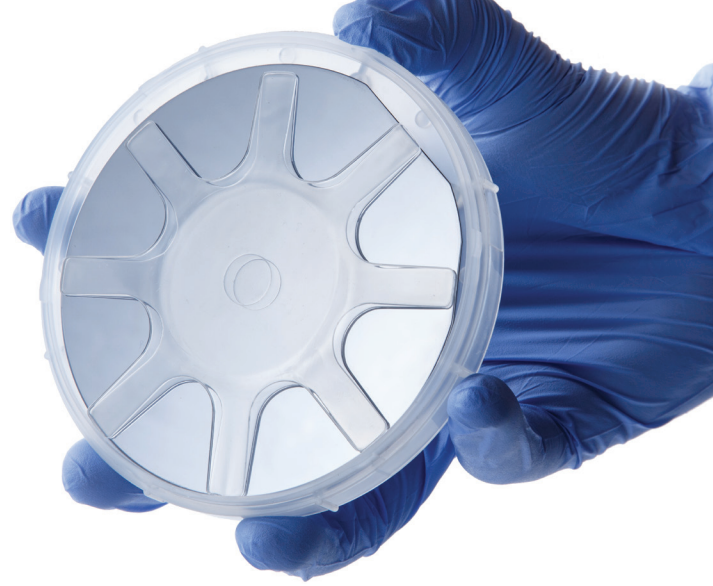
II-VI Wafers

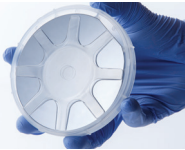

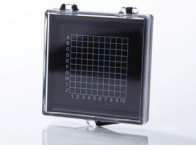

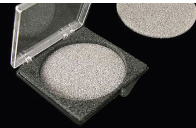
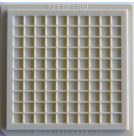
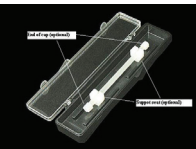
| Name | Formula |
|-----------------------------------|----------|
| Zinc Telluride | ZnTe |
| Zinc Selenide | ZnSe |
| Cadmium Sulphide | CdS |
| Cadmium Telluride | CdTe |
| Cadmium Telluride doped with Zinc | Cd-Zn-Te |

Substrate & Wafer Storage

We offer a wide range of substrate and wafer storage.

Below are our most requested lines, however we welcome any enquiry for other specifications.



| | Product | Description | Sizes |
|---|-----------------------------|---|---|
|  | Individual Wafer Carriers | Each carrier consists of base, lid and retainer spring. Base has concave profile so that only the extreme edge of the wafer is in contact with the carrier. | 1", 2", 3", 4" and 6" |
|  | Multi Wafer Storage Boxes | Each box can hold up to 25 wafers. Lid and box have moulded supports so minimal contact is made with the wafer whilst keeping each wafer secure. | 2", 3" and 4" |
|  | Gel-Sticky Boxes | Designed to protect delicate components by a sticky carrier gel layer. Components or devices are held securely on surface once in contact with the gel layer. The components can be taken off by tweezers or by hand. | 2", 3" and 4" |
|  | Membrane Boxes | High-elastic film designed for packing fragile components with irregular shape or rods. The component is pressed tightly by two layers of high-elastic film and suspended in the middle of the carrier, preventing fragile components from damage. Can be used for various optoelectronic components. | 1", 2", 3", 4" and 5" |
|  | Plastic Foam Module Boxes | This packing is designed to protect delicate parts. Used in many fields like optical materials, optoelectronic components, semiconductor, and optical communication. Consists of three cushions, the middle cushion can be customised to a specific shape. | 3" and 4" single or multiple wafers |
|  | Die / IC Trays | This system provides a safe and convenient packing and delivery solution for bare die, CSP, optoelectronics and other microelectronic devices. Trays, lids and clamps for single and multiple layers available. | 9 - 1600 pockets |
|  | Smart Carrying Box for Rods | Innovative packing box designed for protecting and carrying laser rods or devices of rod shape. Two silicone support seats in the base of the box hold the rods. | Diameter from 3-8mm and up to 160mm (L) |

Ceramic Parts & Components

We offer a wide range of ceramic parts and components.

Below are our most requested lines, however we welcome any enquiry for other specifications.



| | | Description | | |
|---|---|---|--|-----------------------------|
|  |  | Alumina Plates | | |
|  |  | Alumina Rods & Tubes | | |
|  |  |  |  | Alumina Laser Cuts & Custom |

3YSZ - SHEETS

3YSZ is a special partially stabilized zirconia which is used for thin film applications. Among others, it can be used as an ion conductive ceramic membrane for Solid Oxide Fuel Cells (SOFC). This material is characterised by its excellent flexibility, extremely high bending strength and high fracture toughness. Another advantage is that this material can be manufactured in small thicknesses.



| Typical Characteristics | Value/Unit |
|----------------------------------|--------------------------------------|
| Colour | White |
| Density | 6.03 g/cm ³ |
| Surface Roughness R _a | <0.1 μm |
| Bending Strength | >1.000 MPa |
| Thermal Expansion Coefficient | ~10 10 ⁻⁶ K ⁻¹ |
| Thermal Conductivity | 2 W/mK |

| Typical Characteristics | Value/Unit |
|-----------------------------|---|
| Standard Dimension | 101.6 x 101.6mm |
| Thickness | 0.15mm |
| Structure | Dense |
| Mains Components | 95% ZrO ₂ + 5% Y ₂ O ₃ |
| Dielectric Strength at 20°C | >10 kV/mm |

Below are our most requested lines, however we welcome any enquiry for other requirements:

Advanced Materials

Sputtering Targets, Ceramics, Single Crystal & Substrates, Wafers (including Silicon & Glass), Quartz & Sapphire Components, Rare Earth Oxide Powders, Li-ion Battery Powders and Electrodes, Supercapacitor Chemicals, Precious Metals, Graphene, High Temperature Adhesives, Optical Coatings, High Purity Evaporative Coating Pellets, Photovoltaic Chemicals, Nano Powders

Equipment

Chemical Processing and Handling: (Grinding & Polishing Machines, Diamond Blade & Wire Saws)

Thin Film Coating: (Spin Coaters, Dip Coaters, Tape Casting, Sputtering Machines, Spray Coaters)

Li-ion Battery Research Equipment: (Vacuum Mixers, Electrode Coating Machines, Cell Production, Testing & Analysing Machines)

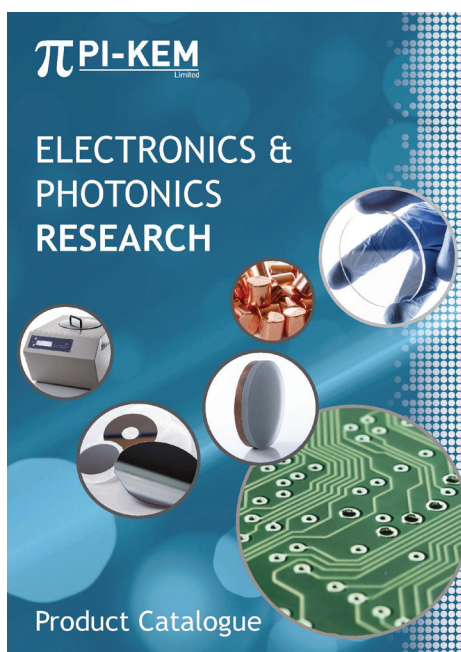
Furnaces: (Tube, Muffle, RTP & CVD Furnaces, Single or Multi Zone)

Ionic Contamination Test Equipment: (Ionographs)

Storage: (Substrate & Wafer Storage, Glove Boxes, Membrane Boxes, Vacuum Desiccators)


Services: (Precious Metals Reclaim Services & Target Bonding)

Please request a copy of our additional product catalogues or visit www.pi-kem.co.uk:



π PI-KEM

 www.PI-KEM.co.uk

 + 44 (0) 1827 259250

 info@pi-kem.co.uk

PI-KEM Limited, Unit 18-20 Tame Valley Business Centre, Magnus, Tamworth, B77 5BY, UK

Registered in England with company number: 04215228 VAT: GB 572885985

Version 1 05.2019