



ENERGY RESEARCH

Product Overview

A BOND WORTH FORMING

WE ENABLE INNOVATION

For over 30 years we've been enabling you to accelerate your research and development, proudly partnering with the most innovative minds in the science and technology sectors.

We're purpose designed to support your science and technology innovation, and take your ideas from lab-based concepts to full-scale production.

With our capabilities and extensive expertise we're the partner of choice for custom manufacturing solutions and niche product sourcing through our trusted network of UK and international suppliers.

Specialising in the following areas:

- Energy Research
- Hydrogen Technology
- Photonics + Optoelectronics
- Thin Films + Nanotech
- Materials Processing + Testing
- RF Shielding
- Electroforming
- Specialist Metallic Coatings

Accelerate your journey. We are PI-KEM.

MICRO-INFO

- 30+ years supplying advanced materials and equipment
- Custom manufactured components
- Niche product sourcing
- Comprehensive range of standard stock products and consumables
- Call off purchase options
- Support from an expert scientific team
- Low minimum order quantity
- UK, European & global delivery

We offer a wide range of advanced materials and equipment which are available as standard or custom manufacture.

Within this catalogue are our most requested lines, however we welcome any enquiry for other specifications.

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Our Partners

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

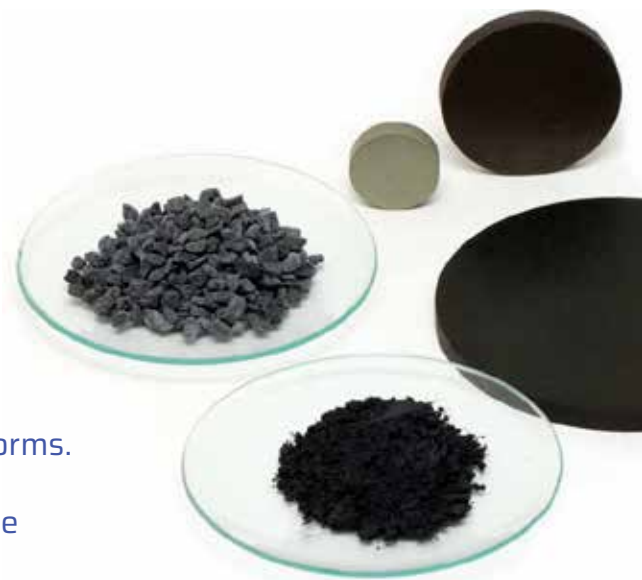


Battery + Supercapacitors:

LITHIUM 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.



Chemical Name	Formula
Lithium Cobalt Oxide	LiCoO_2
Lithium Iron Phosphate	LiFePO_4
Lithium Titanium Oxide	$\text{Li}_2\text{TiO}_3/\text{Li}_4\text{Ti}_5\text{O}_{12}$
Lithium Manganese Oxide	LiMnO_2
Lithium Nickel Oxide	LiNiO_2
Lithium Tantalate	LiTaO_3
Lithium Vanadium Phosphate	$\text{Li}_3\text{V}_2(\text{PO}_4)_3$
Lithium Manganese Cobalt Oxide	$\text{LiMn}_{1-y}\text{Co}_y\text{O}_2$
Lithium Nickel Cobalt Oxide	$\text{LiNi}_{1-y}\text{Co}_y\text{O}_2$
Lithium Nickel Manganese Oxide	$\text{LiNi}_{1-y}\text{Mn}_y\text{O}_2$
Lithium Aluminium Cobalt Oxide	$\text{Li}_x\text{Al}_y\text{Co}_{1-y}\text{O}_2$

Lithium Discs

Lithium discs for li-ion and li-rechargeable battery research

Purity: 99.9%

Diameter: 12mm, 15.6mm, 16mm, 18mm

Thickness: 0.25mm, 0.45mm, 0.6mm, 1mm



Battery + Supercapacitors:

SODIUM MATERIALS

Due to sodium's abundance within the earth's crust, Na-ion battery technology is a new and fast-growing energy research area.

We have all the materials, chemicals, components and equipment you need to help accelerate your Na-ion battery research:



Product	Description
Sodium discs & foils	<ul style="list-style-type: none">Our discs are pre-cut to size for ease of use within coin cell research, whilst the foil can be cut to size for use in pouch or cylinder cell R&D
Anode & cathode powders	<ul style="list-style-type: none">Our sodium-ion cathode materials are typically based on intercalation / de-intercalation compounds, where sodium ions provided by the cathode are inserted into the host lattice (anode) during charge and extracted during discharge, with minimal structural change in the host material
Pre-Coated electrode sheets	<ul style="list-style-type: none">Our sodium-ion cathode and anode powders can also be cast as electrode sheets
Coin / pouch / cylinder cell consumables & equipment	<ul style="list-style-type: none">We provide an extensive choice of equipment for battery and supercapacitor research. This ranges from cost-effective manual and semi-automatic equipment, designed for use in benchtop research, through to automated and high throughput systems for large laboratory research and prototype testing

Sodium Discs

For Na-ion battery research, coated on one side with aluminium to aid current collection

Purity: 99.7%

Diameters: 12.0mm, 14.0mm, 15.6mm, 18mm

Thickness: 0.45mm

Available in batches of 50g



Sodium Foil

Coated on one side with 30µm aluminium to aid current collection

Purity: 99.7%

Diameters: 120mm x 300mm

Thickness: 0.45mm

Na-ion Cathode, Anode & Electrolyte Powders

We supply a variety of sodium-ion battery materials, which include sodium-based cathode and anode materials, their corresponding carbon-coated counterparts (3-5 wt.% carbon), and sodium-based solid electrolytes.

We can customize the primary and secondary particle size, composition, and surface characteristics (e.g, electronically conducting coating layer) of available materials, as well as custom synthesize Na-ion materials upon request.



Na-ion Cathode, Anode & Electrolyte Powders

Chemical Name	Formula	Structure	Material Type
Sodium Chromium Oxide Powder	NaCrO_2	Hexagonal	Cathode
Sodium Cobalt Oxide Powder	$\text{Na}_{0.7}\text{CoO}_{2+x}$	Hexagonal	Cathode
Sodium Manganese Oxide Powder	$\text{Na}_{0.44}\text{MnO}_2$	Hexagonal	Cathode
Sodium Manganese Oxide Powder	$\text{Na}_{0.7}\text{MnO}_{2+x}$	Orthorhombic	Cathode
Sodium Cobalt Phosphate Powder	NaCoPO_4	Orthorhombic	Cathode
Sodium Nickel Phosphate Powder	NaNiPO_4	Orthorhombic	Cathode
Sodium Iron Phosphate Powder	NaFePO_4	Orthorhombic (Maricite)	Cathode
Sodium Manganese Phosphate Powder	NaMnPO_4	Orthorhombic	Cathode
Sodium Iron Hexacyanoferrate ("Prussian Blue") Powder	$\text{Na}_{0.61}\text{Fe}[\text{Fe}(\text{CN})_6]_{0.94}$	Cubic	Cathode
Sodium Manganese Hexacyanoferrate ("Prussian White") Powder	$\text{Na}_{1.79}\text{Mn}[\text{Fe}(\text{CN})_6]_{0.87}$	Unknown	Cathode
Sodium Metatitanate Powder	$\text{Na}_2\text{Ti}_3\text{O}_7$	Monoclinic	Anode
Sodium Titanium Oxide Powder	$\text{Na}_4\text{Ti}_5\text{O}_{12}$	Hexagonal	Anode
Sodium Titanium Phosphate Powder	$\text{NaTi}_2(\text{PO}_4)_3$	Hexagonal	Anode
3 wt.% Carbon-coated Sodium Titanium Phosphate Powder	$\text{NaTi}_2(\text{PO}_4)_3$	Hexagonal	Anode
Sodium Aluminium Titanium Phosphate Powder	$\text{Na}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}\text{P}_3\text{O}_{12}$	Hexagonal	Electrolyte
Hard Carbon Powder			Anode
Soft Carbon Powder			Anode
Kuaray Type2 Hard Carbon			Anode
	$\text{Na}_3\text{V}_2(\text{PO}_4)_3$		Cathode
Sodium Iron Phosphate	$\text{Na}_4\text{Fe}_3(\text{PO}_4)_2\text{P}_2\text{O}_7$		Cathode
Prussian White	$\text{Na}_2\text{Mn}[\text{Fe}(\text{CN})_6]$		Cathode
Prussian Blue	$\text{Na}_2\text{Fe}_2(\text{CN})_6$		Cathode
Layered Oxide	$\text{NaNi}_{1/3}\text{Fe}_{1/3}\text{Mn}_{1/3}\text{O}_2$		Cathode
NASICON	$\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$		Solid State Electrolyte
NASICON (Pellet 19.4mm Dia x 1mm Thickness)	$\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$		Solid State Electrolyte
NPSCL	$\text{Na}_{5.5}\text{PS}_{4.5}\text{Cl}_{1.5}$		Solid State Electrolyte
	NaPF_6		Electrolyte
Sodium Phosphor Sulphur Chloride	$\text{Na}_{5.5}\text{PS}_{4.5}\text{Cl}_{1.5}$		
Sodium Vanadium Phosphate	$\text{Na}_3\text{V}_2(\text{PO}_4)_3$		
Sodium Nickel Iron Manganese Oxide	$\text{Na}(\text{NiFeMn})_{0.4}\text{O}_2$		

Pre-coated Na-ion Cathode & Anode Electrode Sheets

Our sodium-ion cathode and anode powders can also be cast as an electrode sheet, as shown below:



Coated Sheet Dimensions:	5 inches x 10 inches (127mm x 254mm)
Current Collectors:	Copper (10 um) or Aluminium (16 um)
Coating:	Single or Double-sided sheets available, coated edge to edge (unless specified otherwise)
Standard* Composition:	85% active material, 10% conductive carbon, 5% PVDF binder (*except Hard Carbon electrode sheet)

Chemical Name	Formula	Structure	Material Type
Sodium Chromium Oxide Electrode Sheet	NaCrO_2	Hexagonal	Cathode
Sodium Cobalt Oxide Electrode Sheet	$\text{Na}_{0.7}\text{CoO}_{2+x}$	Hexagonal	Cathode
Sodium Manganese Oxide Electrode Sheet	$\text{Na}_{0.44}\text{MnO}_2$	Hexagonal	Cathode
Sodium Manganese Oxide Electrode Sheet	$\text{Na}_{0.7}\text{MnO}_{2+x}$	Orthorhombic	Cathode
Sodium Cobalt Phosphate Electrode Sheet	NaCoPO_4	Orthorhombic	Cathode
Sodium Nickel Phosphate Electrode Sheet	NaNiPO_4	Orthorhombic	Cathode
Sodium Iron Phosphate Electrode Sheet	NaFePO_4	Orthorhombic (Maricite)	Cathode
Sodium Manganese Phosphate Electrode Sheet	NaMnPO_4	Orthorhombic	Cathode
Sodium Iron Hexacyanoferrate ("Prussian Blue") Electrode Sheet	$\text{Na}_{1.79}\text{Mn}[\text{Fe}(\text{CN})_6]_{0.94}$	Cubic	Cathode
Sodium Manganese Hexacyanoferrate ("Prussian White") Electrode Sheet	$\text{Na}_{1.79}\text{Mn}[\text{Fe}(\text{CN})_6]_{0.87}$	Unknown	Cathode
Sodium Metatitanate Electrode Sheet	$\text{Na}_2\text{Ti}_3\text{O}_7$	Monoclinic	Anode
Sodium Titanium Oxide Electrode Sheet	$\text{Na}_4\text{Ti}_5\text{O}_{12}$	Hexagonal	Anode
Sodium Titanium Phosphate Electrode Sheet	$\text{NaTi}_2(\text{PO}_4)_3$	Hexagonal	Anode
3 wt.% Carbon-coated Sodium Titanium Phosphate Electrode Sheet	$\text{NaTi}_2(\text{PO}_4)_3$	Hexagonal	Anode
Hard Carbon Electrode Sheet	C	n/a	Anode

Modifications can also be made to accommodate customers with unique specification requirements, such as different active material loadings, coating thickness, and binder type / content upon request.

Please contact our expert Energy & Research team with your specifications.

SOLID STATE ELECTROLYTES

We can also provide a range of new generation solid-state electrolytes including lithium phosphorous sulphides and doped lithium lanthanum zirconium oxides. Please see below for our most common lines but we welcome the opportunity to collaborate on custom R&D projects.

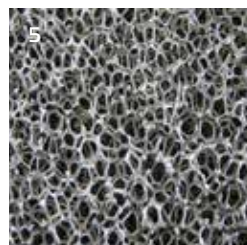
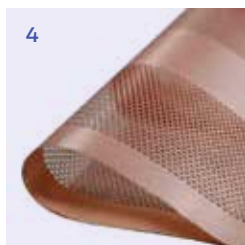


Chemical Name	Formula
Lithium Phosphorus Sulphide	$\text{Li}_3\text{PS}_4 / \text{Li}_7\text{P}_3\text{S}_{11}$
Lithium Phosphorus Sulphur Chloride	$\text{Li}_6\text{PS}_5\text{Cl}$
Lithium Phosphorus Sulphur Bromide	$\text{Li}_6\text{PS}_5\text{Br}$
Lithium Phosphorus Sulphur Iodide	$\text{Li}_6\text{PS}_5\text{I}$
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 Aluminium Germanium Phosphate	$\text{LiAlGeP}_3\text{O}_{12}$
Lithium Germanium Phosphorus Sulphide	$\text{Li}_{10}\text{GeP}_2\text{S}_{12}$
Lithium Germanium Phosphorus Sulphide Chloride	$\text{Li}_{10}\text{GeP}_2\text{S}_{12}\text{Cl}$
Lithium Silicate	Li_2SiO_3
Lithium Lanthanum Titanium Oxide	LiLaTiO_3
Lithium Lanthanum Zirconium Oxide	$\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$
Aluminium doped Lithium Lanthanum Zirconium Oxide	$\text{Li}_{7-3x}\text{Al}_x\text{La}_3\text{Zr}_2\text{O}_{12}$
Gallium doped Lithium Lanthanum Zirconium Oxide	$\text{Li}_{6.4}\text{Ga}_{0.2}\text{La}_3\text{Zr}_2\text{O}_{12}$
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	$\text{Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{Ta}_{0.25}\text{O}_{12}$ $\text{Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{Ta}_{0.6}\text{O}_{12}$
Tungsten doped Lithium Lanthanum Zirconium Oxide	$\text{Li}_{6.3}\text{La}_3\text{Zr}_{1.65}\text{W}_{0.35}\text{O}_{12}$
Sodium Thioantimonate	Na_3SbS_4
Sodium Phosphorus Sulphide	Na_3PS_4

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
1 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) • $\text{LiMn}_{1.5}\text{Ni}_{0.5}\text{O}_4$
2 Discs/Chips <ul style="list-style-type: none"> • Lithium discs for Li-ion and Li-rechargeable battery research • For Na-ion battery research, coated on one side with aluminium to aid current collection 	Lithium: <ul style="list-style-type: none"> • Purity: 99.9% • Diameter: 15.6mm • Thicknesses: 0.25mm, 0.45mm Sodium: <ul style="list-style-type: none"> • Purity: 99.7% • Diameters: 12.0mm, 14.0mm, 15.6mm • Thickness: 0.45mm • Available in batches of 50g
3 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)
4 Mesh	<ul style="list-style-type: none"> • Aluminium (Al) • Copper (Cu)
5 Foam	<ul style="list-style-type: none"> • Cobalt (Co) • Graphene • Nickel (Ni) • Silver (Ag) • Titanium (Ti)



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
1 Coin Cells	<ul style="list-style-type: none">Coin/Button Cell Cases: CR2032, CR2025, CR2016, CR2450, CR1220, CR2325Wave Springs, Spacers, Belleville WashersKapton Cells for X-Ray analysisMeshed Cells for Li-Air researchGold, Platinum & Aluminium Coated options
2 Cylinder Cells	<ul style="list-style-type: none">Cylinder Cell Cases: 14500, CR123, 18650, 21700, 26650, 32650Tabs: Nickel & Aluminium in 3mm, 4mm & 8mm widthsStainless Steel & Aluminium Cases available
3 Pouch Cells	<ul style="list-style-type: none">Aluminium Laminated Foils - Plane & Pre-formed CasesTabs: Nickel & Aluminium in 3mm, 4mm & 8mm widthsCustom Dies for cell formingHot Melt Sealing Adhesives in 4mm, 5mm, 8mm and 30mm widths
4 Split Test Cells	<ul style="list-style-type: none">Split Test Cells for Coin, Cylinder & Pouch Cells3-Electrode, Gold coatedQuartz & Beryllium window options for Raman/X-Ray analysis8-Channel Cell for high throughput testing
5 Prismatic Cell Cases	<ul style="list-style-type: none">Aluminium Material CaseVarious sizes & capacities availableTabs & Sealing Plug included



LAB-SCALE 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.

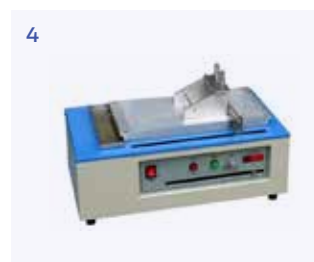
Product	Description
1 Electrode Coating Preparation	<ul style="list-style-type: none"> Tape Casters (Doctor Blade) with Vacuum Chuck; Heated Bed or Cover Heater Options Roll-to-Roll Coaters Rolling Presses (Calendars) Dip Coaters
2 Coin /Button Cell Preparation	<ul style="list-style-type: none"> Pneumatic, Hydraulic or Electric Coin Cell Crimping/Disassembling Machines Dies to fit various cell sizes Disk Cutters
3 Chemical Preparation / Analysis	<ul style="list-style-type: none"> Tube & Vacuum Furnace Rotary & High Pressure Furnace Ball Mill & Mixer
4 Battery Testing Systems	<ul style="list-style-type: none"> 5V - 50V, 1mA - 30A Battery Analyser with 1-8 Channels & Laptop Controlled
5 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
6 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
7 Cylinder/Prismatic Cell Preparation	<ul style="list-style-type: none"> Cylinder Grooving & Crimping Winding Tab/Spot Welding Electrode Slitting



Coin Cell Pilot Line

These are examples only; many other pieces are also available.

	Process	Product
1	Furnace	4" Two Zone Rotary CVD Tube Furnace 1200° Max
2	Milling	High Speed Vibrating Ball Mill with 2 Jars 80ml SS and Nylon
3	Mixing	Compact Dual-Shaft Planetary Vacuum Mixer with one 150 mL container
4	Electrode Coating Preparation	Compact Tape Casting Film Coater with Dryer, Vacuum Chuck & Adjustable Film Applicator
5	Rolling Press (Calendering)	8" Dia. x 10" Width Hot Rolling Press with Dual Micrometer up to 80° with Variable Speed
6	Vacuum Oven	NRTL Certified 53L 200°C Vacuum Oven (16.3x13.6x14.7", 1.9 Cu-Ft) with Digital Temperature Controller
7	Disc Cutting	Precision Disc Cutter with Standard 16, 19, 20mm Dia. Cutting Die and 3 - 24 mm Dia. Optional Die
8	Glove Box	Glove Box with H ₂ O & O ₂ Purification System and Openable Front Window
9	Coin Cell Assembly	See Coin Cell Consumables
10	Electrolyte Filler	Automatic Digital Bottle Dispenser with one 32 Oz Glass Bottle for 0 - 50 mL Electrolyte
11	Crimping	Compact & Fast Gas Driven Crimper for CR20XX Series Coin Cells, Clean Room and Argon Gas Compatible
12	Testing	8 Channel Battery Analyzer (0.002 mA- 1 mA, up to 5V) with Adjustable Cell Holder and Laptop & Software



PILOT-LINE EQUIPMENT

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

Electrode preparation

	Process	Product
1	Planetary Vacuum Mixing	10 Litre Large Planetary Vacuum Mixer with Vacuum Pump and Water Chiller
2	Filtration	Magnetic De-ironing Filtration System 5 Litre for Battery Electrode Slurry
3	Roll to Roll Coating & Drying	Faster Roll to Roll Transfer Coating System 4 Metres per Minute
4	Dual-Filtration for NMP Vapor	Dual-Filtration System for NMP Vapor of Li-ion Battery Coating
5	Rolling Press	Roll to Roll Pressure Controlled Rolling Press
6	Vacuum Drying	150°C Larger Capacity 360 Litres Vacuum Drying Oven with Tri-Level Shelf Heating Modules



Pouch cells

	Process	Product
1	Die Cutting	R2R Automatic Precision Die Cutter for Pouch Cell Electrodes
2	Electrode Stacking	Full Automatic Layer by Layer Stacking Machine for Pouch Cell up to 160L x 100W (mm)
3	Pouch Forming	R2R Automatic Pouch Case Forming Machine for Pilot Scale Pouch Cell Production
4	Pouch Sealing	Automatic Vacuum Sealer Integrated with Electrolyte Injection & Diffusion



Cylinder / prismatic cells

	Process	Product
1	Electrode Slitting	Roll to Roll Automatic Precision Edge Slitting Machine
2	Roll to Sheet Cutting	Automatic Roll to Sheet Cutting Machine for Cylindrical Battery Electrodes
3	Ultrasonic Welding	Desktop 800 W Ultrasonic Metal Welder Maximum 40 KHz
4	Winding	Automatic Precision Winding Machine 10 PPM Speed
5	Grooving	Floor-stand Automatic Grooving Machine for Batch Processing of Cylindrical Battery Castings
6	Laser Welding	300W Laser Welding System for Prismatic and Cylindrical Cell Cap Sealing
7	Electrolyte Diffusion & Degassing	Electrolyte Diffusion and Degassing Chamber System
8	Cylindrical Cell Crimping	Floor-stand Automatic Cylindrical Cell Crimping Machine



Dry room

A self-assembly walk-in dry room (3m x 3m) which provides a cost effective solution, and holds a range of MTI equipment. It has the equivalent working area to 10 standard sized glove boxes, with a dew point of < -40°C ~ 79 ppm) making it an ideal solution for a Li-ion battery pilot line. Contact us for more details.

Dry room main part



SAFETY TESTING EQUIPMENT

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

Lithium-ion Battery Pack Safety Testing Equipment

	Process	Product
1	Altitude Simulation	215L Vacuum Chamber (22"x 25" x 24") with Digital Pressure Control
2	Thermal Test	1000L Programmable Fast Thermal Test Chamber (-70°C - +150°C, UN38.3.4.2)
3	Vibration	Computerized Automatic Vibration Testing System for Max. 15kg Load (UN38.3.4.3)
4	Shock	Automated Pneumatic Shock Tester with Max. Load of 10 Kg (UN 38.3.4.4)
5	External Short Circuit	Short Circuit Testing System with Remote Control up to 1000A for Rechargeable Batteries (UN38.3.4.5)
6	Impact / Crush	Gravity Impact Tester with Remote Control & Free Fall Option for Lithium Battery (UN 38.3.4.6 & IEC 62133)
7	Overcharge	- 8 Channel Battery Analyzer (10A 30V per Channel) with Laptop & Software for All Types of Batteries & Packs - Dual Explosion-Proof Box for Battery Safety Test (20"x20"x20", 125L, UN38.3.4.7 & 8)
8	Thermal Abuse	Thermal Chamber (131L, 200°C Max.) w/ 8 Channel Battery Analyzer and Laptop & Software for Battery Thermal Cyclic Test
9	Nail Penetration	2T Max. Hydraulic Driven Crushing & Nail Penetration Tester with Digital & Remote Control

1



2



3



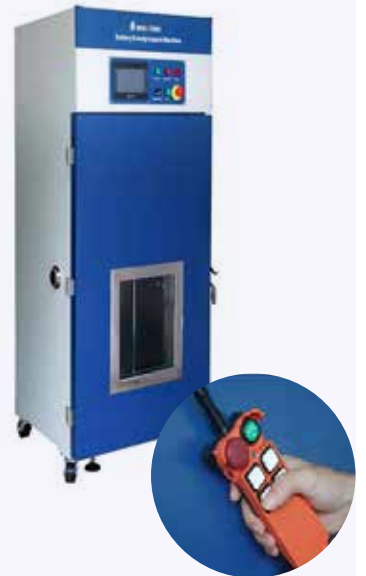
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7



8



9



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 %
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

Interconnect powders

Chemical	Standard weight %
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

Cathode powders

Chemical	Standard weight %
La/Ca/Mn Oxide	<ul style="list-style-type: none"> • La_{0.6}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

Electrolytes

Chemical	Standard weight %
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



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.

Photoactive Materials & Transparent Conducting Oxides (TCOs)

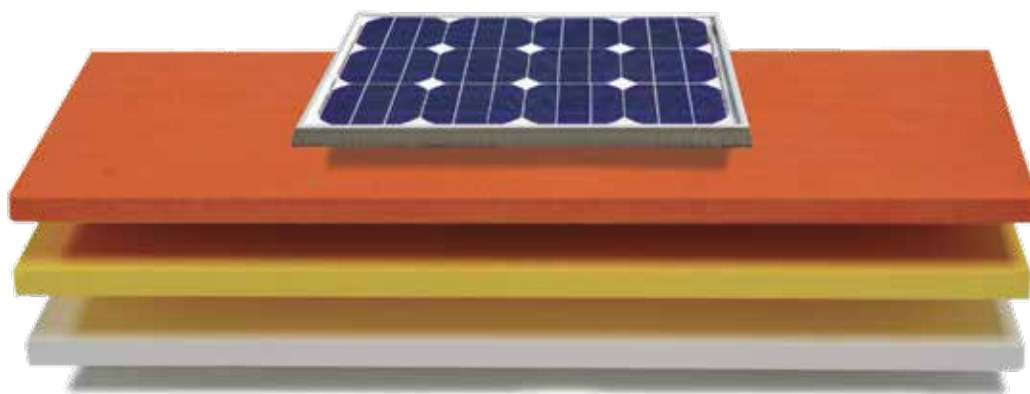
Chemical Name	Formula
OXIDES	
Gallium Zinc Oxide	$\text{Ga}_2\text{O}_3:\text{ZnO}$
Indium Tin Zinc Oxide	$\text{In}_2\text{O}_3:\text{SnO}_2:\text{ZnO}$
Indium Zinc Oxide	$\text{In}_2\text{O}_3:\text{ZnO}$
Indium Gallium Tin Oxide	$\text{In}_2\text{O}_3:\text{Ga}_2\text{O}_3:\text{SnO}_2$
Indium Gallium Zinc Oxide	$\text{In}_2\text{O}_3:\text{Ga}_2\text{O}_3:\text{ZnO}$
Indium Gallium Manganese Oxide	$\text{In}_2\text{O}_3:\text{Ga}_2\text{O}_3:\text{MnO}_3$
Zinc Oxide	ZnO
Zinc Aluminium Oxide	$\text{ZnO}:\text{Al}_2\text{O}_3$
Zinc Tin Oxide	$\text{ZnO}:\text{SnO}_2$
SELENIDES	
Copper Selenide	Cu_2Se
Copper Indium Selenide	CuInSe_2
Copper Indium Gallium Selenide	CuInGaSe
SULPHIDES	
Cadmium Sulphide	CdS
Copper Sulphide	Cu_2S
Copper Indium Sulphide	CuInS_2
Copper Gallium Sulphide	Cu_2GaS_3
TELLURIDES	
Cadmium Telluride	CdTe

Conventional & Custom Selenides, Tellurides & Other Salts

Chemical Name	Formula
ARSENIDES	
Cadmium Arsenide	Cd_3As_2
Gallium Arsenide	GaAs
OXIDES	
Cadmium Oxide	CdO
Cadmium Oxide/Tin Oxide	CdO/SnO_2
Cadmium Tungsten Oxide	CdWO_4
PHOSPHIDES	
Indium Phosphide	InP
SELENIDES	
Cadmium Selenide	CdSe
Copper Indium Gallium Selenide	CuInGaSe_2 / $\text{CuIn}_{0.7}\text{Ga}_{0.3}\text{Se}_2$ (CIGS)
Copper Indium Selenide	CuInSe_2 (CIS)
Copper Zinc Tin Selenide	CuZnSnSe
STANNATES	
Cadmium Stannate	Cd_2SnO_4
SULPHIDES	
Copper Zinc Tin Sulphide	CuZnSnS
Cadmium Sulphide	CdS
TELLURIDES	
Cadmium Telluride	CdTe
Cadmium Zinc Telluride	CdZnTe (CZT)

You might be interested in...

[Wafers \(including Silicon, Glass, and Semi-Conductor Wafers on pages 21-23\)](#)



Alloy Targets

Chemical Name	Formula
Indium Tin	In_xSn_y
Indium Antimony	In_xSb_y
Zinc Aluminium	Zn_xAl_y

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.

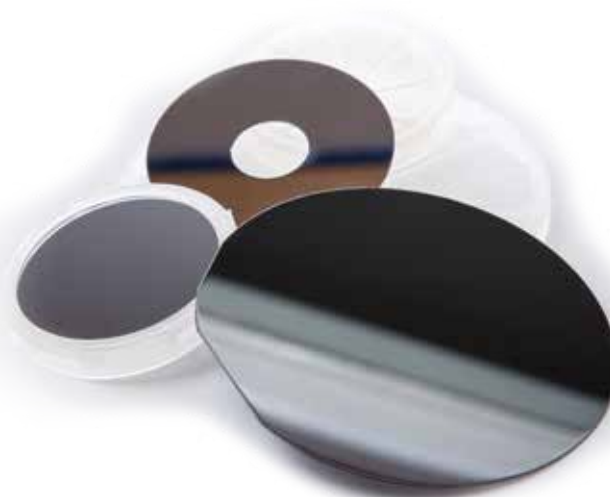
Laboratory Equipment

Product	Description
1 Spin Coaters	<ul style="list-style-type: none"> 7", 8", 12" & 15" Bowl Diameters Manual & programmable options Manual, Semi-Automatic, Automatic & Multi 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
2 Dip Coaters	<ul style="list-style-type: none"> Up to 60cm x 45cm Manual & programmable options
3 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



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 (choose from the following)

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.

Resistivity

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

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

Orientation

Orientation	Tolerance
<100>	
<110>	Standard +/- 0.5° & Custom up to +/- 0.05°
<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 <2Å / Total Thickness Variation (TTV) <1µm. 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
SiO2 Silicon Dioxide	Wet Oxidation	200-3000	From 1" to 6"
	High Purity Dry Oxidation	20-300	
	Single face oxidation also available		
Si3N4 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" (depending on metals)
Other metal coatings & multi-layer deposition available on request			

Dicing Services

Form	Specifications
Tiles	E.g. 10mm x 10mm, 20mm x 20mm (minimum size 1.5mm x 1.5mm)

OTHER 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	Product	Description	Sizes
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

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

Silicon Carbide Wafers

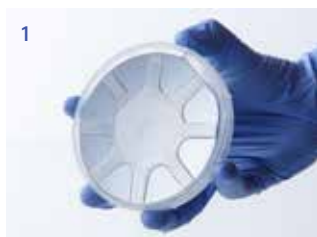
The use of Silicon Carbide (SiC) in the semiconductor industry has expanded due to its advantageous physical properties, including its hardness, high thermal conductivity and low coefficient of thermal expansion.

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.

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.

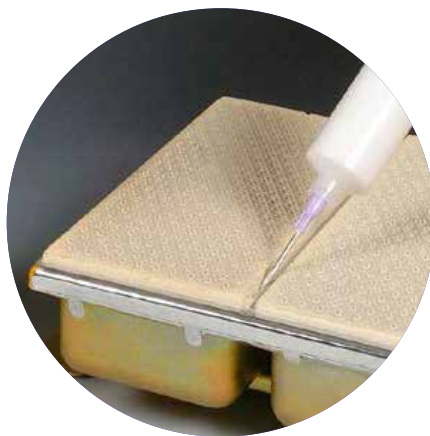
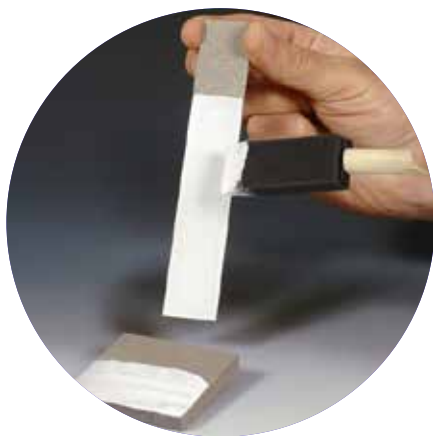
	Product	Description	Sizes
1	Individual Wafer Carriers	Each carrier consists of base, lid and retainer spring. Base has concave profile so that only the extreme edge of the wafer is in contact with the carrier.	1", 2", 3", 4" and 6"
2	Multi Wafer Storage Boxes	Each box can hold up to 25 wafers. Lid and box have moulded supports so minimal contact is made with the wafer whilst keeping each wafer secure.	2", 3" and 4"
3	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"
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"
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
6	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
7	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)



HIGH TEMP 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
High Temperature Electrical Coatings & Sealants	<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
High Temperature High Emissivity Coatings	<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>

Ultra High Temperature Ceramic Coatings

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).

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.

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.

Alumina Plates



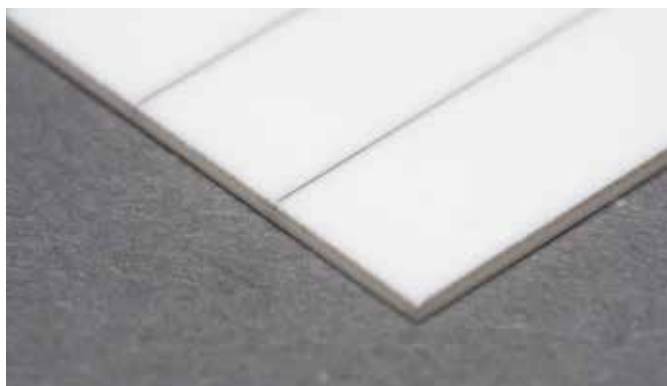
Alumina Rods & Tubes



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
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



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