Thin-Film Technology Made to Order...

Thin-Films
Research, Inc.

Thin-Films Research, Inc.
270 Littleton Road
Westford, MA 01886

tel: 978 692.9530 fax: 978 692.9531

sales@thinfilmsresearch.com
www.thinfilmsresearch.com

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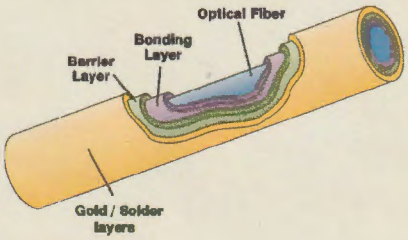
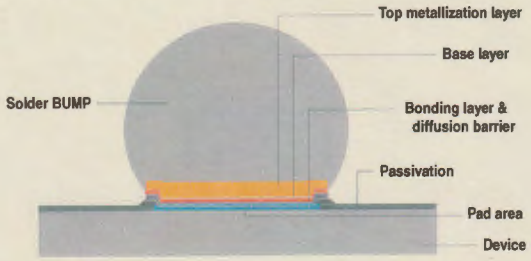
Serving thin-film requirements of the electro-optics, semiconductors, sensors & medical electronics industries.

APPLICATION REPORT 108

INNOVATIVE SOLUTIONS FOR PHOTONICS PACKAGING

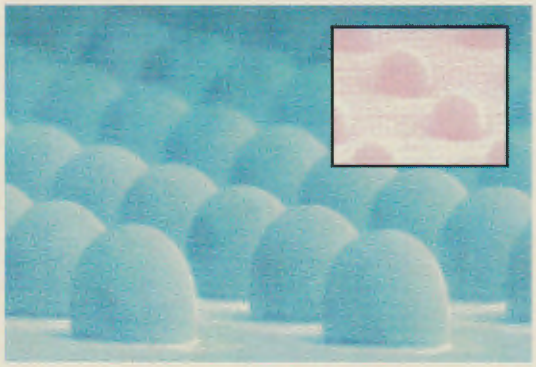
- *BUMPS Technology FOR FLIP CHIP Packaging*
- *Eutectic Solder layers coated Optical fibers*





Production proven Metal BUMPS technology with Metals & Alloy compositions using:

- *INDIUM*
- *COPPER*
- *GOLD*
- *LEAD:TIN (Pb:Sn)*
- *GOLD:TIN (Au:Sn)*
- *GOLD: GERMANUIM (Au:Ge)*



-Eutectic Solder BUMPS deposited using Computer controlled co-deposition technology to achieve precise alloy compositions

Metallized Optical Fibers

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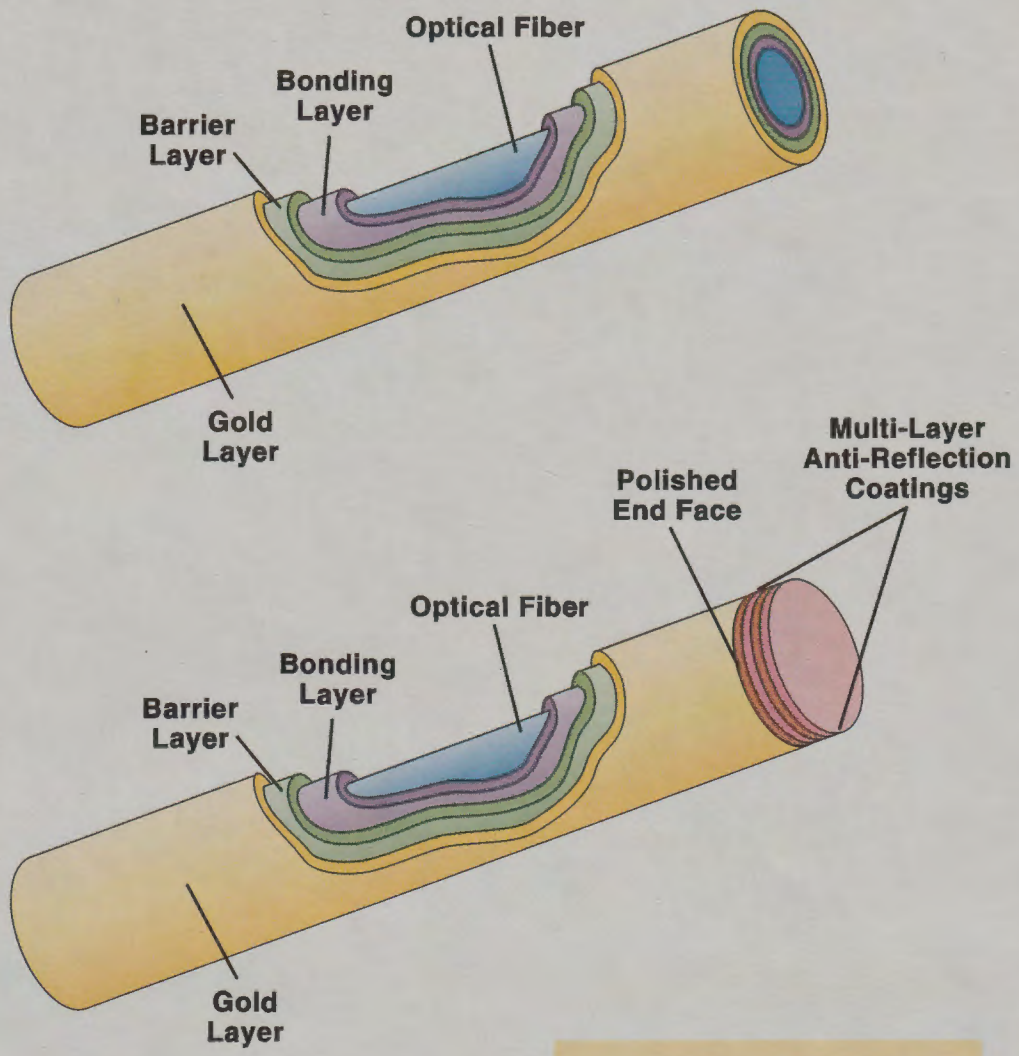

Stress free multi-layer metallization of optical fibers for connectivity, reflection, etc.

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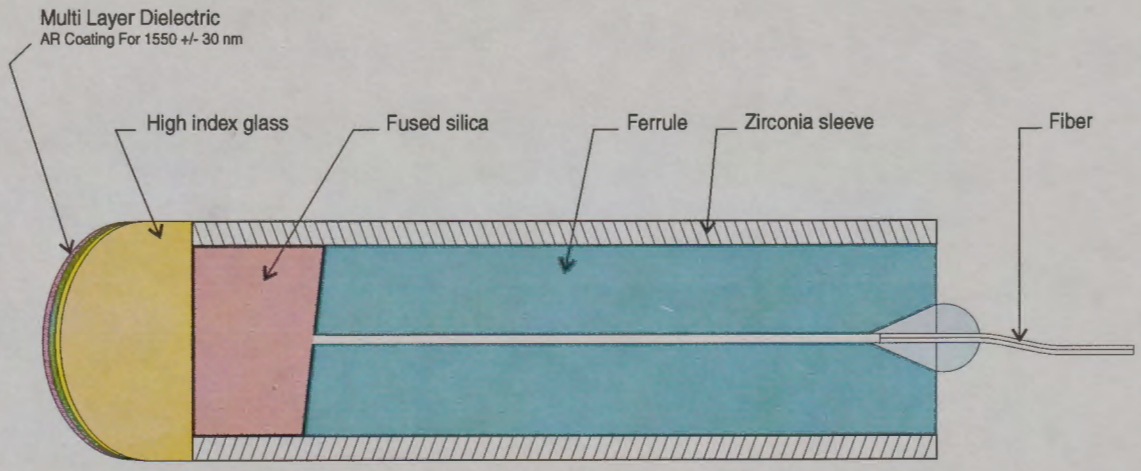
AR Coated Lensed Fibers

We produce actively aligned, rugged, lensed fibers with Durable multilayer Dielectric coatings on the spherical lens. Over all dimensions of Zr-sleeve is -10.5 mm long and OD +3.2mm. Standard fiber length is 1 meter.



Construction Features: *Durable multi-layer dielectric coatings, low absorption characteristics, environmentally stable, robust & easy to clean. Each piece is optically actively aligned.*

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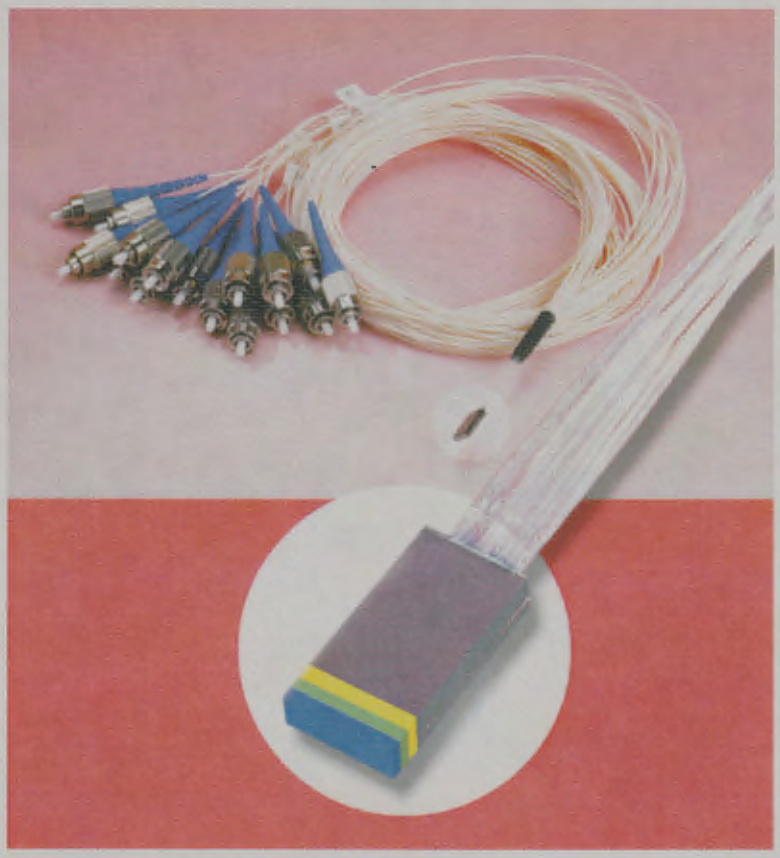
AR Coated Linear Fiber Arrays

We produce custom Linear single mode or multi-mode fiber arrays with angle polished end silicon v-grooves. Polished ends are AR coated.

Multilayer, all dielectric AR coatings are applied for peak performance at specified wavelengths in 1350 to 1650 nm range.

Applications: Optical switches, attenuators, optical Isolators, R&D etc.



Construction Features: *Silicon v-grooves, Durable multi-layer dielectric coatings, low absorption characteristics, environmentally stable, robust & easy to clean.*

Please specify: Number of fibers, pitch, wavelength, type of fiber, polishing angle.

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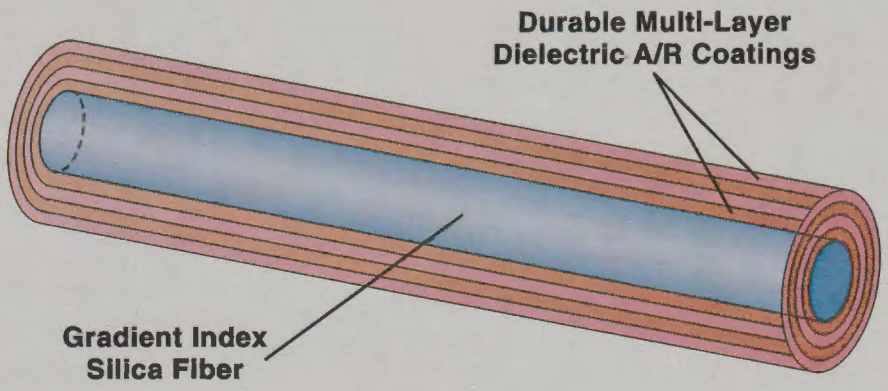
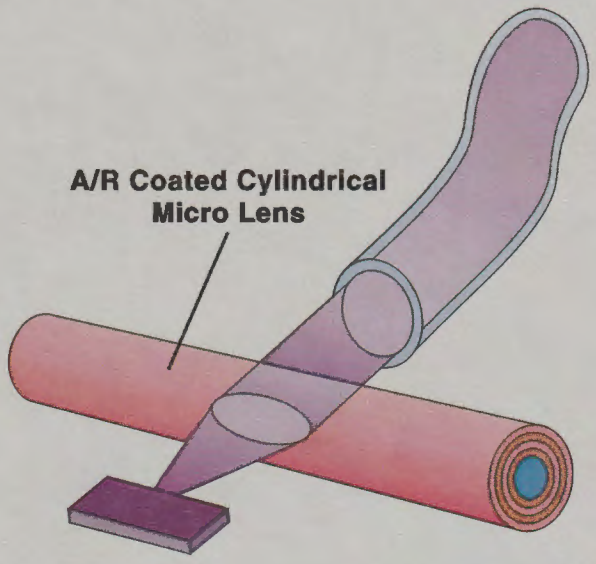
Anti-Reflection Coated Optical Fibers and Cylindrical Micro Lenses





Features:

Diameter:
60 microns to 5 mm in custom lengths.

A/R Coatings:
Durable multi-layer dielectric coatings.

Spectral Region:
600 nm to 1550 nm.

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Announcing The Addition Of New Process Capabilities :

Ion Assisted Depositions (IAD)

And

Ion Beam Pre-cleaning/etching (IBC)

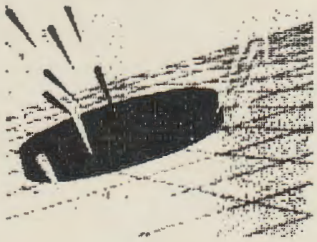
Ion Assisted Depositions Of Thin Films :

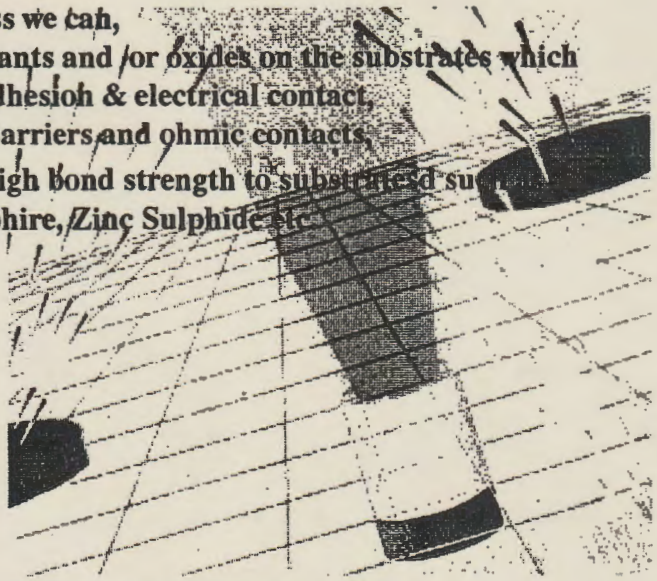
Using our versatile Kaufman type Ion Beam Source we can now grow highest quality thin films of many unique properties.

- **Films of high bond strength to substrates.**
- **Films of reduced stress.**
- **Films of High packing densities (such as for passivation films)**
- **Optical layers of increased refractive indices & transmission.**
- **Improved step coverage & coating parts of intricate shapes.**
- **Influence stoichiometry in various benificial ways.**
- **Reactive deposition of dense passivation layers such as Silicon Nitride & Silicon Monoxide.**

Ion Beam Pre-cleaning Process :

- **By employing this process we can, remove native contaminants and /or oxides on the substrates which otherwise may inhibit adhesion & electrical contact,**
- **form superior Schottky Barriers and ohmic contacts.**
- **Produce films of very high bond strength to substrates such as Aluminum Nitride, Sapphire, Zinc Sulphide etc.**





For a complete list of services offered, please refer to our brochure enclosed here.

Serving thin-films needs of Semiconductors, Ceramics and Electro-Optics industries.

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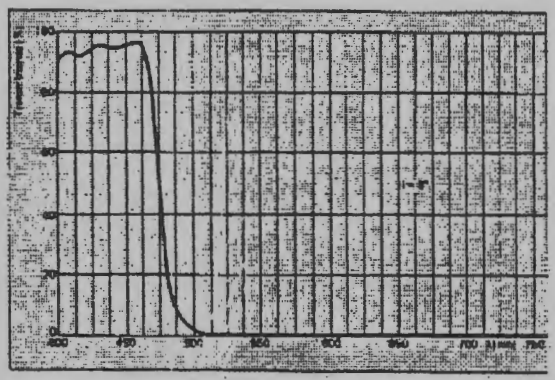
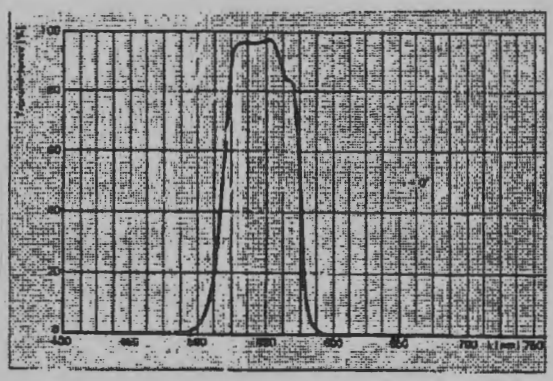
PRODUCT
BULLETIN 501

DICHROIC FILTERS :



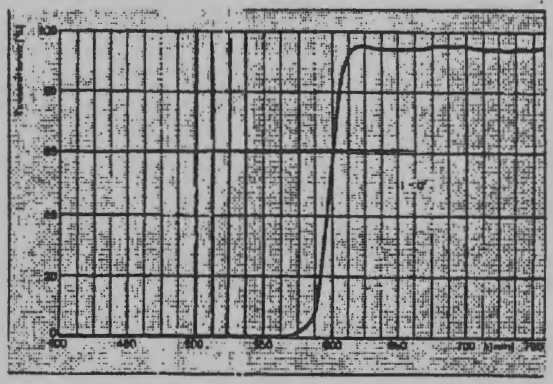
DF-501-Blue

T > 90% ave. 400 nm-480 nm
T > 85% abs. 400 nm - 460 nm
T= 50% 475+/-10 nm
T < 1 % abs. 505 nm - 760 nm



DF-501-Green

T < 1% abs. 400-480 nm
T=50% 500+/-7.5 nm.
T > 90% avg. 530-555 nm.
T > 85% abs. 530-555 nm
T = 50% 570+/- 7.5 nm
T < 1% abs. 600 - 750 nm



DF-501-Red

T < 1% abs. 400-570 nm
T = 50% 600 +/- 10 nm
T> 90% avg. 630 - 760 nm
T > 85% abs. 630 - 760 nm

Construction Features : Durable multi-layer dielectric coatings, low absorption charateristics, environmentally stable, robust & easy to clean.

Substrate : Heat resistant Borosilicate Glass, 1 mm thick. Available in sizes from 10 X 10 mm up to 160 X 110 mm.

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Product Bulletin 502

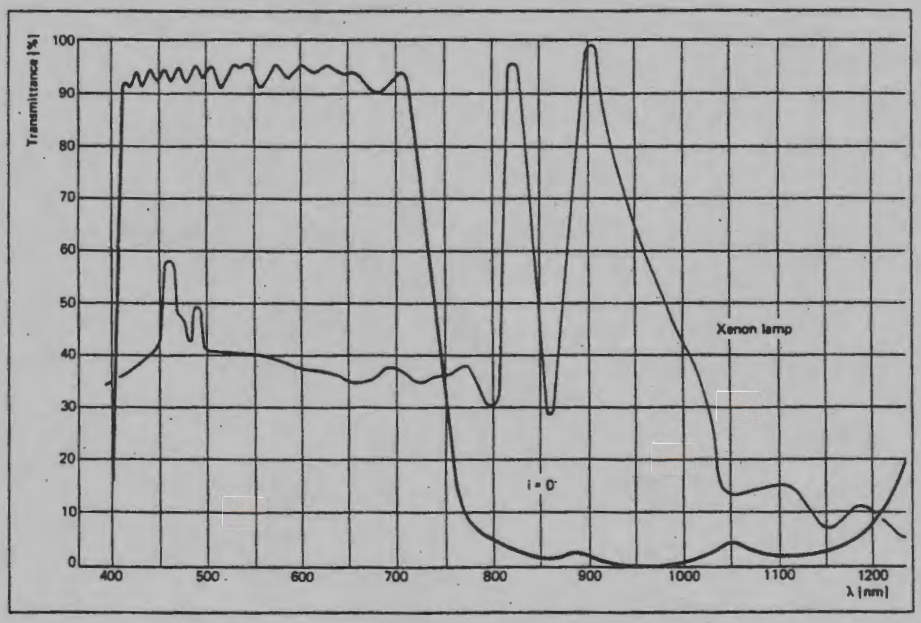
IR Reflecting Filters

We produce several types of Heat Reflecting Filters using Durable multilayer Dielectric coatings.

By adding these filters directly to beam path the temperature can be reduced by effectively reflecting IR radiation while transmitting more than 85% of the visible spectrum.

Some of these filters also provide the added benifit of UV suppression.

By varying the angle of incidence the exact cut-on and cut-off points can be shifted. The slanting angle of incidence leads to a shift of the cut-off slope to shorter wave lengths.



Heat protection filter
Nonbinding principle curve

Construction Features : **Durable multi-layer dielectric coatings, low absorption charateristics, environmentally stable, robust & easy to clean.**
Transmittance : T > 85% average between 425 & 680 nm.
T < 5% average between 800 & 1150 nm

Substrate : **Heat resistant Borosilicate Glass, 1 mm thick. Available in sizes ranging from 10 X 10 mm to 160 X 110 mm.**
Custom Fabrications on request.

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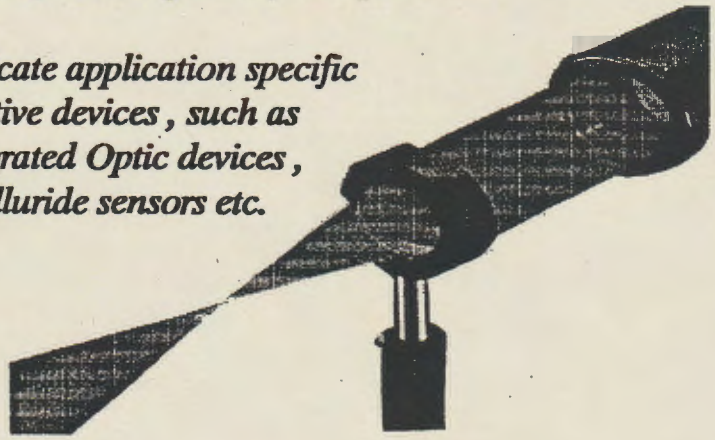
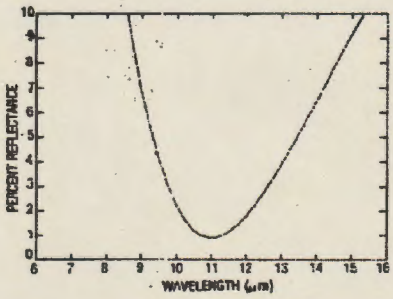
APPLICATION REPORT 104

Custom Designed Optical Coatings :

Using computer aided design and leading edge technology, we offer state of the art solutions to your optical needs, covering the :
Visible, Ultaviolet and Infrared regions of the spectrum.

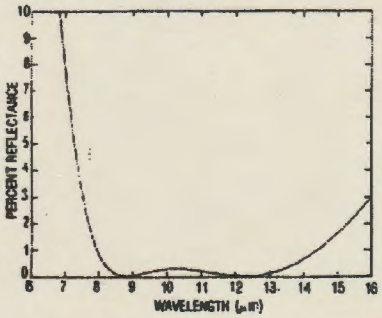
We also design & fabricate application specific optical coatings on active devices , such as Lithium Niobate Integrated Optic devices , Mercury Cadmium Telluride sensors etc.





Single - Layer Design.

Multi - Layer Design.



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APPLICATION REPORT 101

Thin film Depositions Under Oxygen Partial Pressure:

(With Ion Beam Pre-cleaning and Ion Assisted Depositions)

We can now grow highest quality thin film layers under precisely controlled oxygen partial pressures, either by Electron Beam or by Thermal Evaporation processes.

This process can be used to deposit stoichiometric layers of oxides from source materials that are prone to dissociation during evaporation or to form oxides reactively during depositions.

By employing Ion Assisted Deposition process, films of very high packing densities with improved refractive indices can be grown.

The following are some of the oxide layers we can now deposit using this process :

1. Aluminum Oxide (Al_2O_3)
2. Silicon Dioxide (SiO_2)
3. Magnesium Oxide
4. Titanium Dioxide (TiO_2)
5. Iron Oxide
6. Niobium Oxide
7. Tantalum Oxide
8. Tungsten Oxide
9. Zirconium dioxide
10. Ruthenium Oxide

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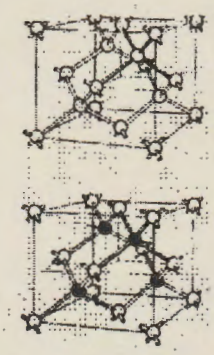
APPLICATION REPORT 103

Thin-film Metallizations of:



Diamond Substrates

&

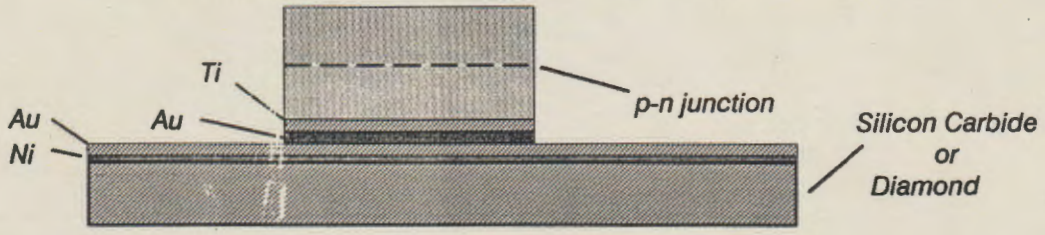
Silicon Carbide Substrates.

Because of their excellent thermal conductivity, Diamond & Silicon Carbide substrates are being used more frequently for superior thermal management of Semiconductor and Electro - Optical devices under performance.

Using our proprietary processes we can now grow durable and rugged thin-films of various metals on these substrates, rendering them suitable for mounting electronic components.

Some of the typical metallization layers are Nickel, Copper, Silver, Gold, Palladium, Platinum, Titanium etc.

Please contact us for a discussion of your specific needs.



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APPLICATION REPORT 107

Custom Designed Thin-Film Circuits :

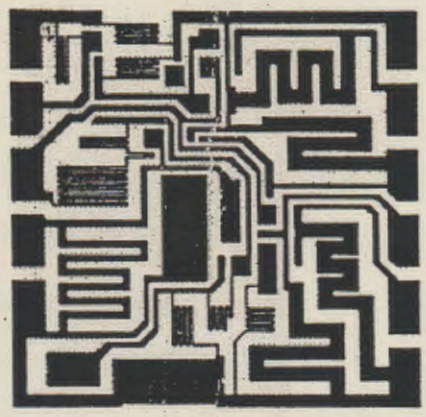
We design and fabricate, application specific Thin-Film resistor/conductor circuits on various **Ceramic** and **Quartz** substrates for micro-electronic applications.

Some of the Resistor layers we can deposit are : **Nichrome (NI/Cr)**

Sichrome (SI/Cr)

Cermet (Cr/SIO)

Tantalum Nitride Etc.



Stoichiometry of the films are computer controlled to achieve the desired TCR & Sheet resistance values. Passivation layers are applied where necessary.

Conductive patterns : These are usually madeup of several layers, chosen to meet complex requirements of adhesion, diffusion barrier, contact resistance, solderability, thermal management etc.

Some of the conductive systems are **Ti/Pd/Au, Ti-W/Ni/Au, Cr/Ni/Au, Cr/Cu/Au, Ti/Pt/Au etc.**

Multiple layers are deposited without breaking the vacuum, for high reliability.

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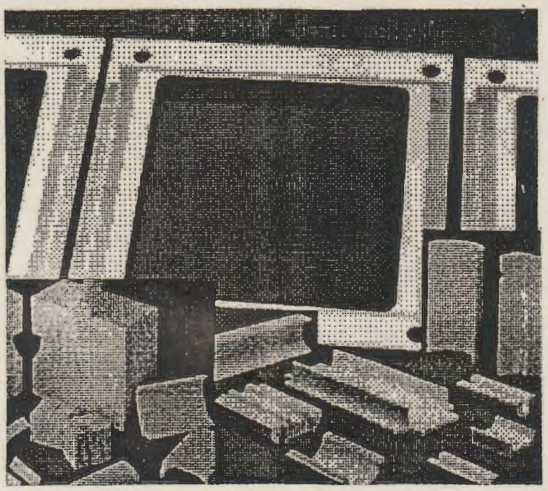
APPLICATION REPORT 105

Custom Thin-Film Coatings On Machinable Ceramics

Machinable ceramics such as **MACOR** & **Micalux** are finding wide applications in Sensors and Electronics Industries.

We can now deposit rugged thin- film coatings on intricate parts making them suitable for attachment of various devices or for making electrical connections.

We can also provide optical coatings on finished surfaces for high reflectivity etc.



Using our proprietary processes we can deposit durable multi layer metallizations. Further machining of the parts after coatings are done, is possible.

Patterning of the metal layers on these ceramic substrates can also be done, to suit individual needs.

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PRODUCT BULLETIN 508

Metallized Ceramic Wafers

(Al_2O_3, BeO, AlN)

Substrate Sizes: 1" x 1" to 12" x 12"; Custom sizes and shapes available

We design and fabricate application specific Thin-Film resistor/conductor circuits on various Ceramic and Quartz substrates for micro-electronic applications.

Custom Conductive Patterns: These are usually made up of several layers, chosen to meet complex requirements of adhesion, diffusion barrier, contact resistance, solderability, and thermal management etc.

Multiple layers are deposited without breaking the vacuum, for high reliability.

Custom sizes and metal thicknesses available.

Metallized with: Ti-Pt-Au
or
Ti-Ni-Au
or
Ti-Ni-Cu-Au

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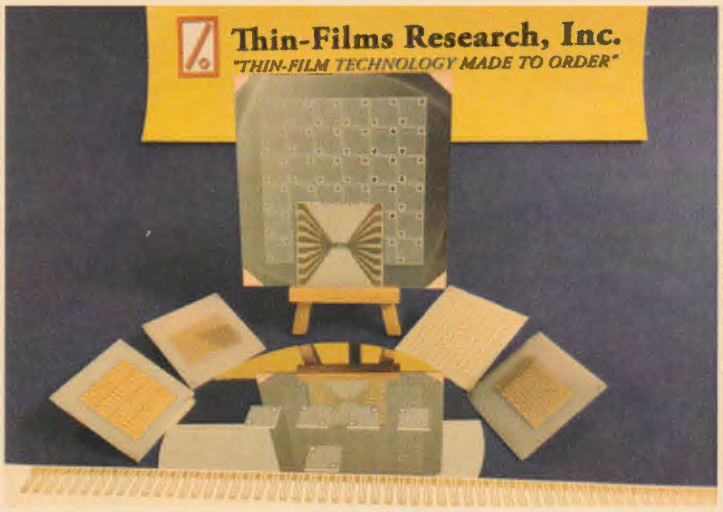
APPLICATION REPORT 102

Custom Designed Thin-Film Circuits

We design and fabricate application specific Thin-Film resistor /conductor circuits on various Ceramic and Quartz substrates for micro-electronic applications.



Stoichiometry of the films is computer controlled to achieve the desired TCR & Sheet resistance values. Passivation layers are applied where necessary.

Some of the Resistor layers we can deposit are: Nichrome (Ni/Cr)
Sichrome (Si/Cr)
Cermet (Cr/SiO)
Tantalum Nitride etc.

Conductive Patterns: These are usually made up of several layers, chosen to meet complex requirements of adhesion, diffusion barrier, contact resistance, solderability, and thermal management etc.

Some of the conductive systems are **Ti/Pd/Au, Ti-W/Ni/Au, Cr/Ni/Au, Cr/Cu/Au, Ti/Pt/Au etc.**

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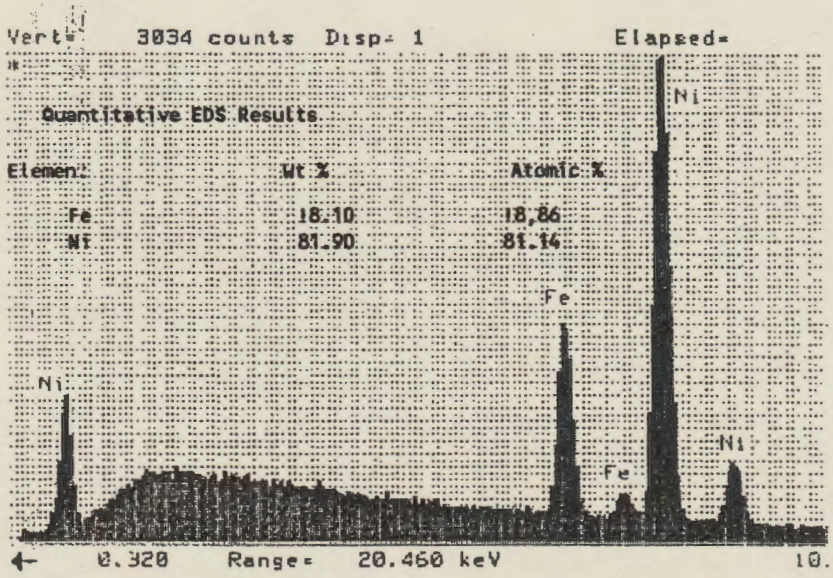
APPLICATION REPORT 106

Computer Controlled Co-Deposition of two Materials To Form :

- **Exotic Alloys** (Cobalt silicide, Gold/Tin eutectic layers etc.)
- **Magnetic Thin-Films** (Permalloy, Samarium/Cobalt etc.)
- **Thin-Film resistor layers** such as Sichrome (Si/Cr) with very low TCR

(With Ion Beam Pre-cleaning and Ion Assisted Depositions)



Simultaneous deposition of two materials, from computer controlled separate sources offers high degree of flexibility to custom tailor the stoichiometry and assures reproducibility.

This process eliminates many disadvantages such as dissociation and non uniform target erosion, inherent with depositions from a single composite target material.

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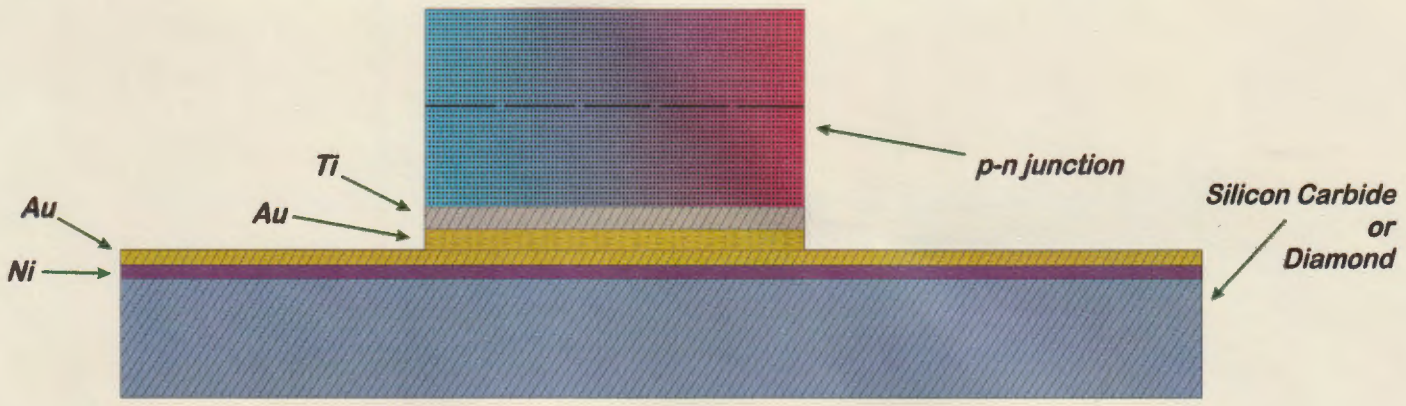
APPLICATION REPORT 121

Thin Film Coatings for Thermal Management

- Metallized High thermal Conductivity Carrier Substrates
- Diamond Substrates
- Aluminum Nitride substrates
- Silicon Carbide Substrates
- Thin Film Phase change materials
- **GeTe Layers**
- GeSbTe Layers
- Dense Carbon and Graphene Layers

Please contact us for a discussion of your specific needs.



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Versatility In Thin-Film Technology !

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Serving thin-film requirements of the electro-optics, semiconductors, sensors & medical electronics industries.

Custom Thin-film Coatings For Optics & Lasers

Depositions Of Transparent Conductive Coatings(ITO)

Heat Reflecting Optical Filters

Metallizations Of Thin Flexible Materials And Optical Fibers

Depositions for "lift-off" Process

Beam Splitters , UV Blocking Filters & Dichroic Filters

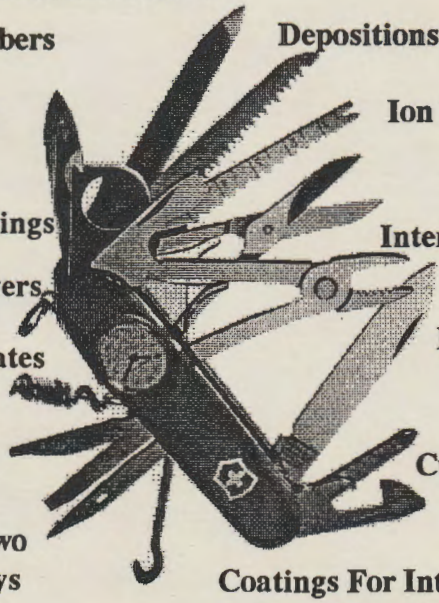
Ion Beam Pre-cleaning

Barrier Metals

Custom Designed Optical Coatings

Inter-diffusion Studies

Depositions Of Dielectric Layers



Metallized Ceramic Substrates

Metallizations On PZT wafers

Ion Assisted Depositions

Custom A/R Coatings

Simultanious Depositions Of Two Materials To Form Exotic Alloys

Coatings For Integrated Optics & Fiber Optic Sensors

Metallizations For Machinable Ceramics (MACOR)

Class-1000 Clean-room Processing

Custom Thin-Film Coatings For Semiconductors, Electro-Optics, Medical Electronics & Ceramics Industries

Servicing thin-film needs of Electro-Optics, Sensors and Medical Electronics industries

Materials Deposited:

Aluminum
Aluminum Fluoride
Aluminum Copper (1-4% Cu)
Aluminum Oxide
Aluminum Silicon (1-2% Si)
Aluminum Copper Silicon (4% Cu)
Barium & Barium Fluoride
Cadmium Telluride
Carbon
Cermet (Cr-SiO)
Chromium
Chrome Oxide
Cobalt
Copper
Copper Oxide
Germanium
Germanium Oxide
Gold
Gold/Germanium Alloy
Indium
Indium Tin
Indium Tin Oxide

Materials Deposited (continued)...

Indium Oxide
Iron & Iron Oxide
Lead
Lead Selenide
Lead Sulphide
Magnesium
Magnesium Fluoride
Magnesium Oxide
Manganese
Molybdenum
Molybdenum Oxide
Nickel
Nickel Chrome
Nickel Iron
Niobium
Niobium Oxide
Palladium
Platinum
Rhodium
Ruthenium
Silicon
Silicon Dioxide
Silicon Monoxide
Silicon Nitride
Silicon Carbide
Silver
Tantalum
Tantalum Carbide
Tantalum Oxide
Tin
Tin Oxide
Titanium
Titanium Carbide
Titanium Nitride
Titanium Oxides
Tungsten
Tungsten Carbide
Tungsten Oxide
Tungsten Titanium (90:1
Yttrium
Yttrium Oxide
Zinc Selenide
Zinc Sulphide
Zinc Telluride
Zirconium
Zinconium Monoxide & Dioxide

Custom thin-film technology for electro-optics, semiconductors, sensors & medical electronics.

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