Kinetic Metallization™

Direct Write of Antenna Aperstructures and Electronic Interconnects Using Kinetic Metallization

ITSC

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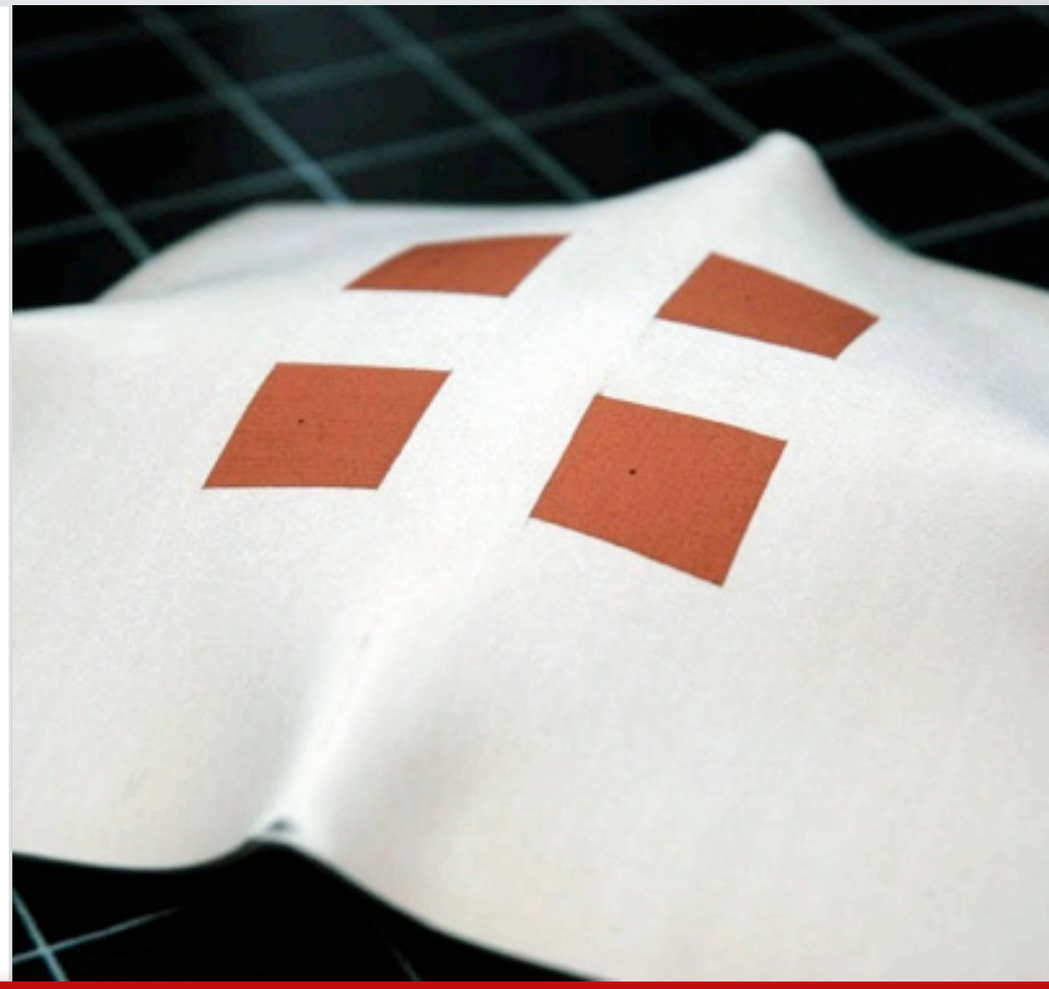
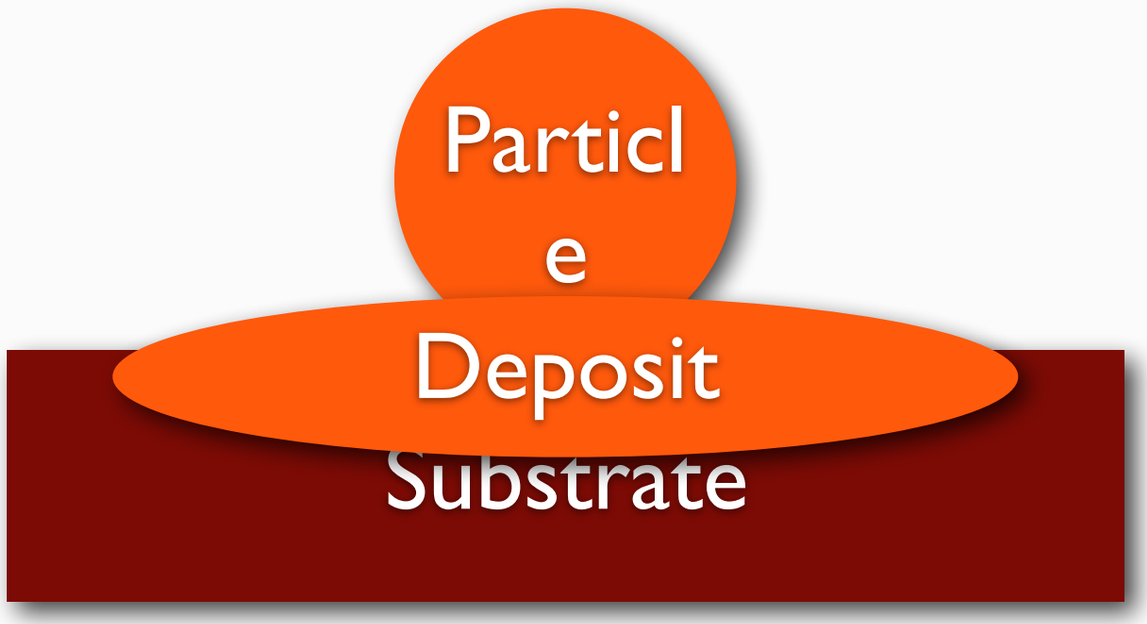
Direct Write of Antenna Elements

- Historical Methods
  - Chemical/mechanical etching
  - Direct write ink-jet printing
  - Laser ablation
- Direct Write - Kinetic Metallization
  - Conductors (Cu,Ag, Ni, Solder)
  - Dielectrics (Ultem, PTFE, Lexan)

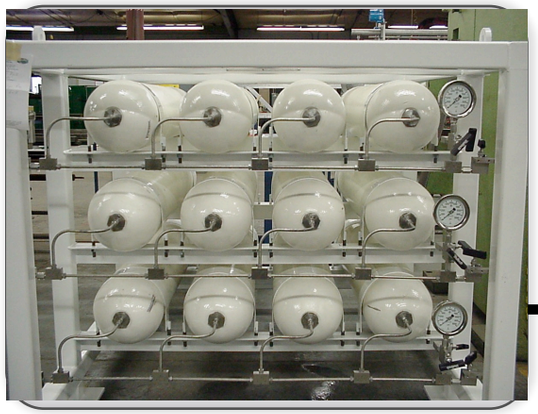


Introduction to Kinetic Metallization™ (KM)

- Metal deposition through particle impact
- low-temperature << melting point
- high particle velocity > 500 m/s
- gas velocity below Mach 1
  - He, 300K, 980 m/s
  - GN2, 300K, 330 m/s



Gas Storage System



Powder Fluidizing Unit

Thermal Conditioning Unit

Heat ?

Deposition Nozzle

Kinetic Energy

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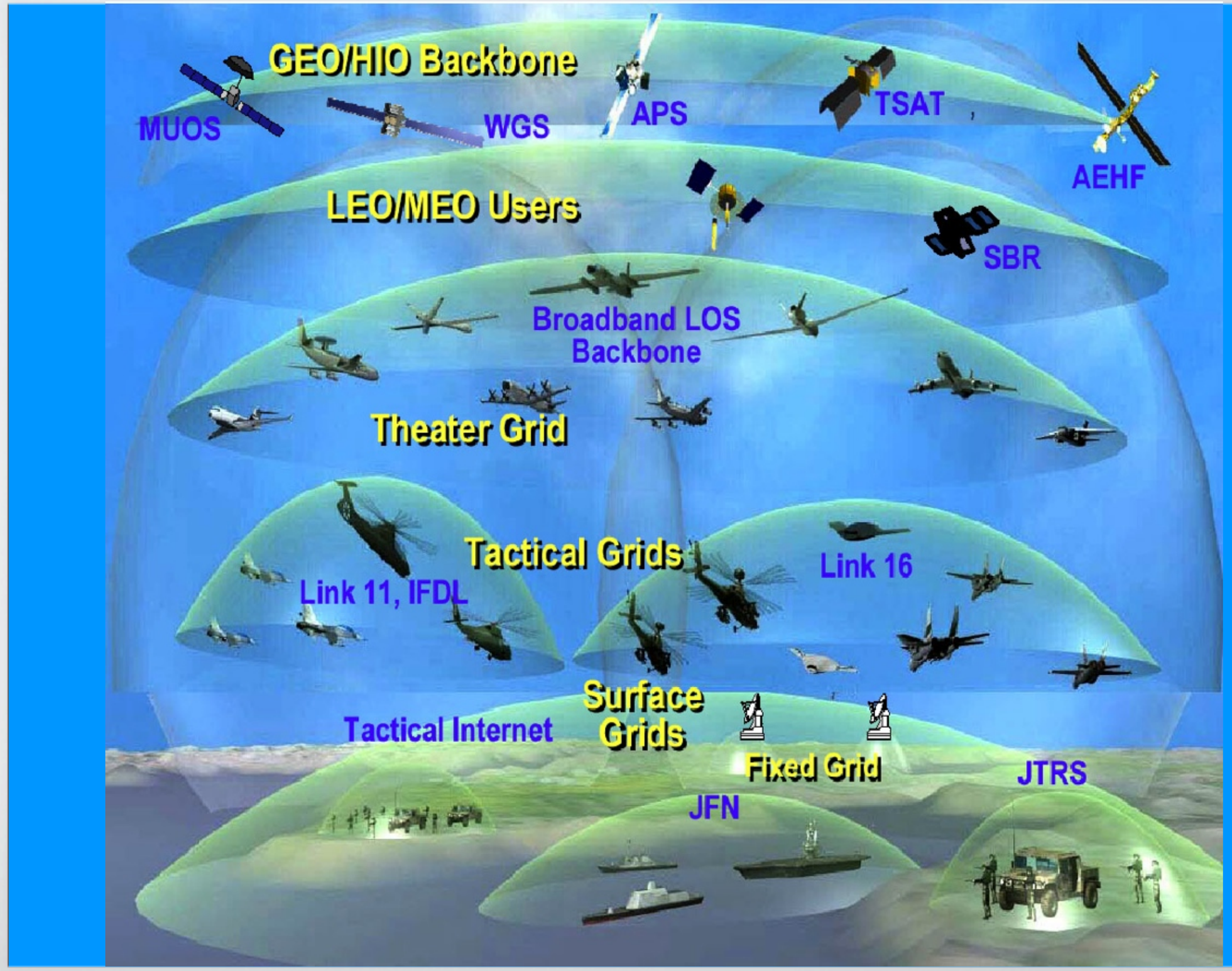
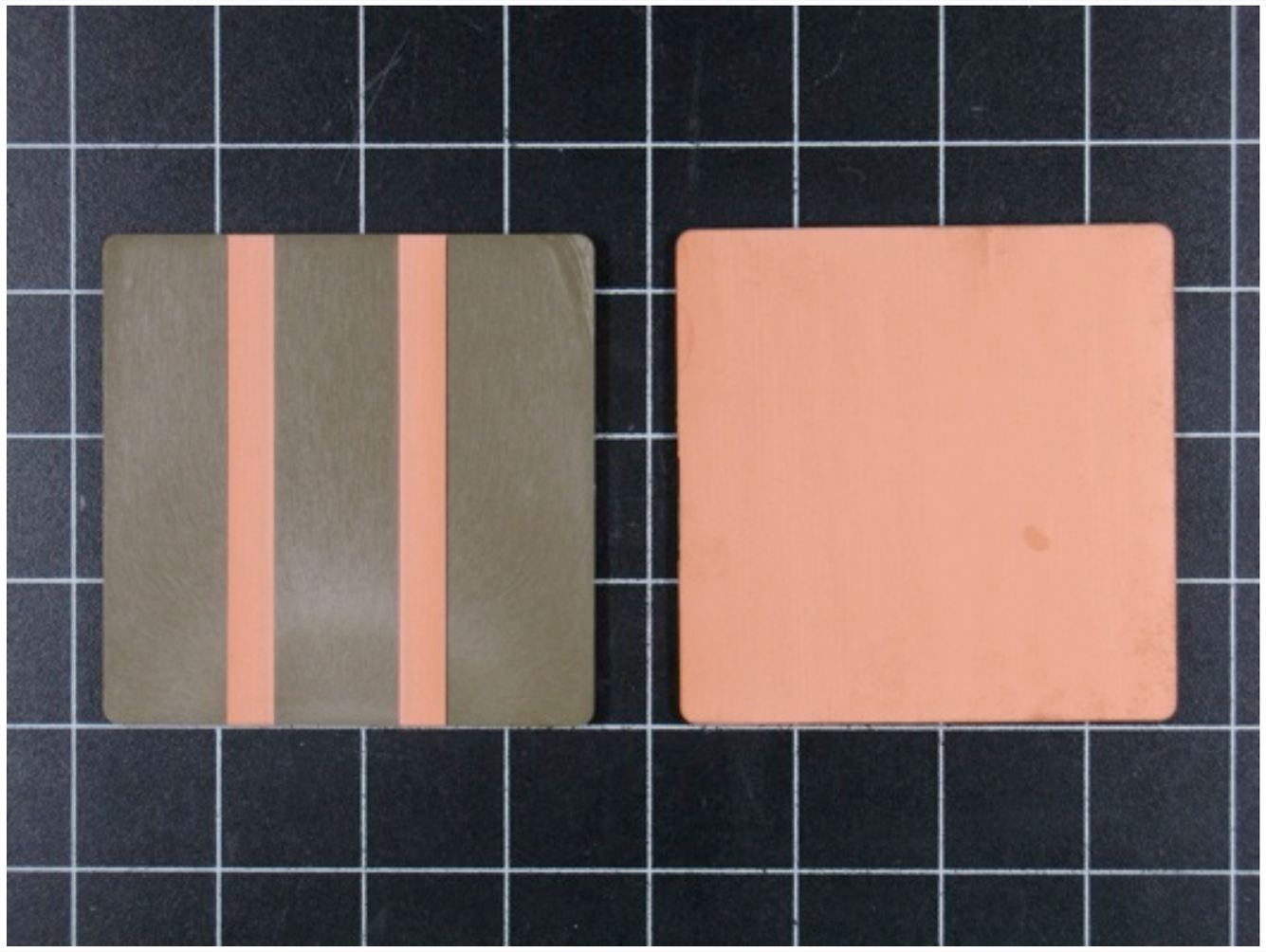
Kinetic Metallization Systems

- KM Systems
  - Low temperature & Pressure (1 MPa)
  - KM-CDS, KM-PCS, & KM-MCS
  - Customers Worldwide
- KM Coatings
  - Cu, Ag, Ni on polymers & ceramics
  - Polymer coatings (Ultem, PTFE)
  - Wear resistant coatings (WC-Co)
  - Corrosion resistant coatings (Al-Trans®)
  - Oxidation resistant coatings (MCrAlY)
  - Braze filler coatings (4047-Al)



Military Global SatCom Grid

Microstrip transmission line test coupons with copper coatings on PTFE-Fused Silica composite (RO3003) substrates.



Microstrip Transmission Lines
KM Cu on Ultem-6202 Plastic

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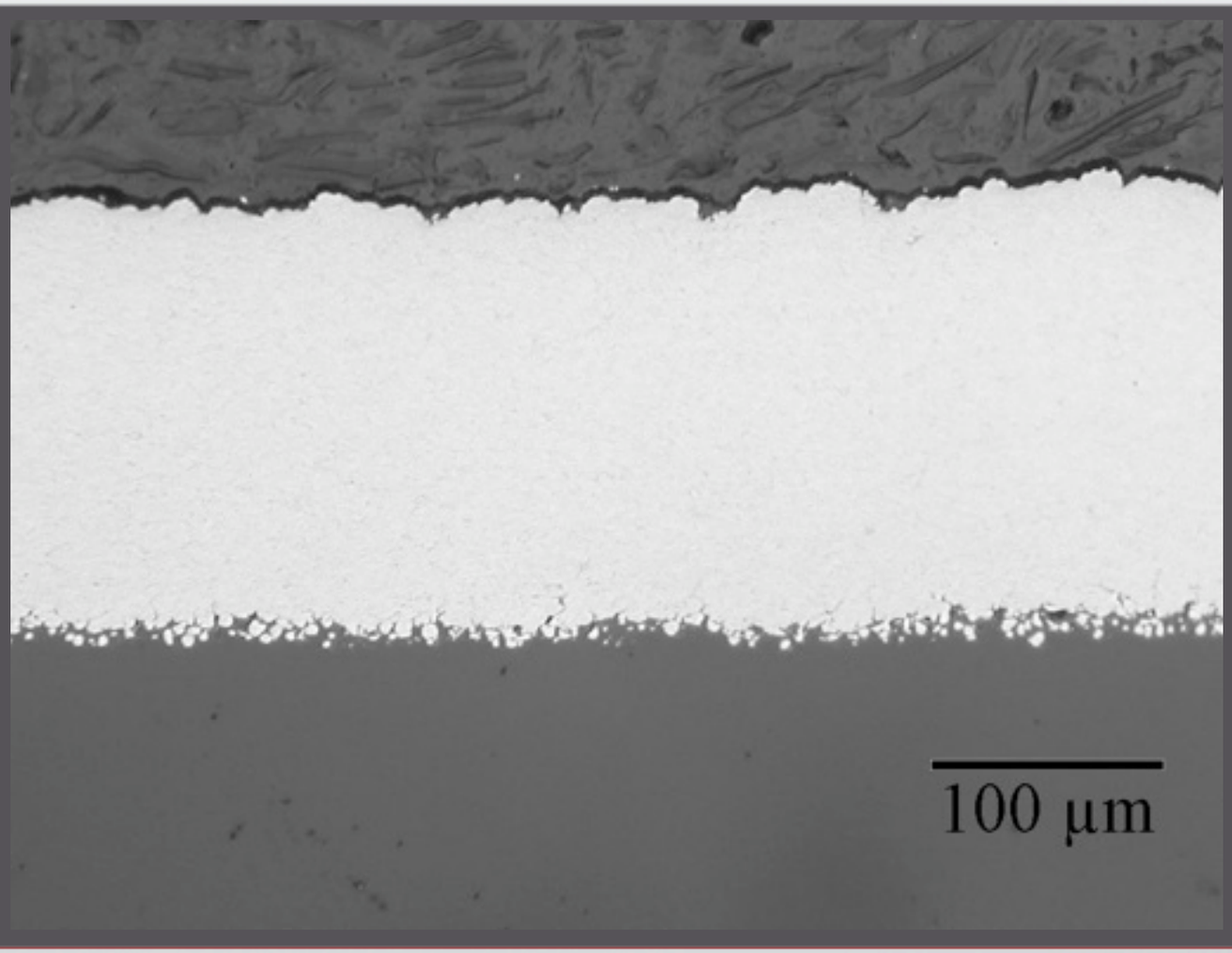
Micrograph of
KM Cu on Ultem Plastic



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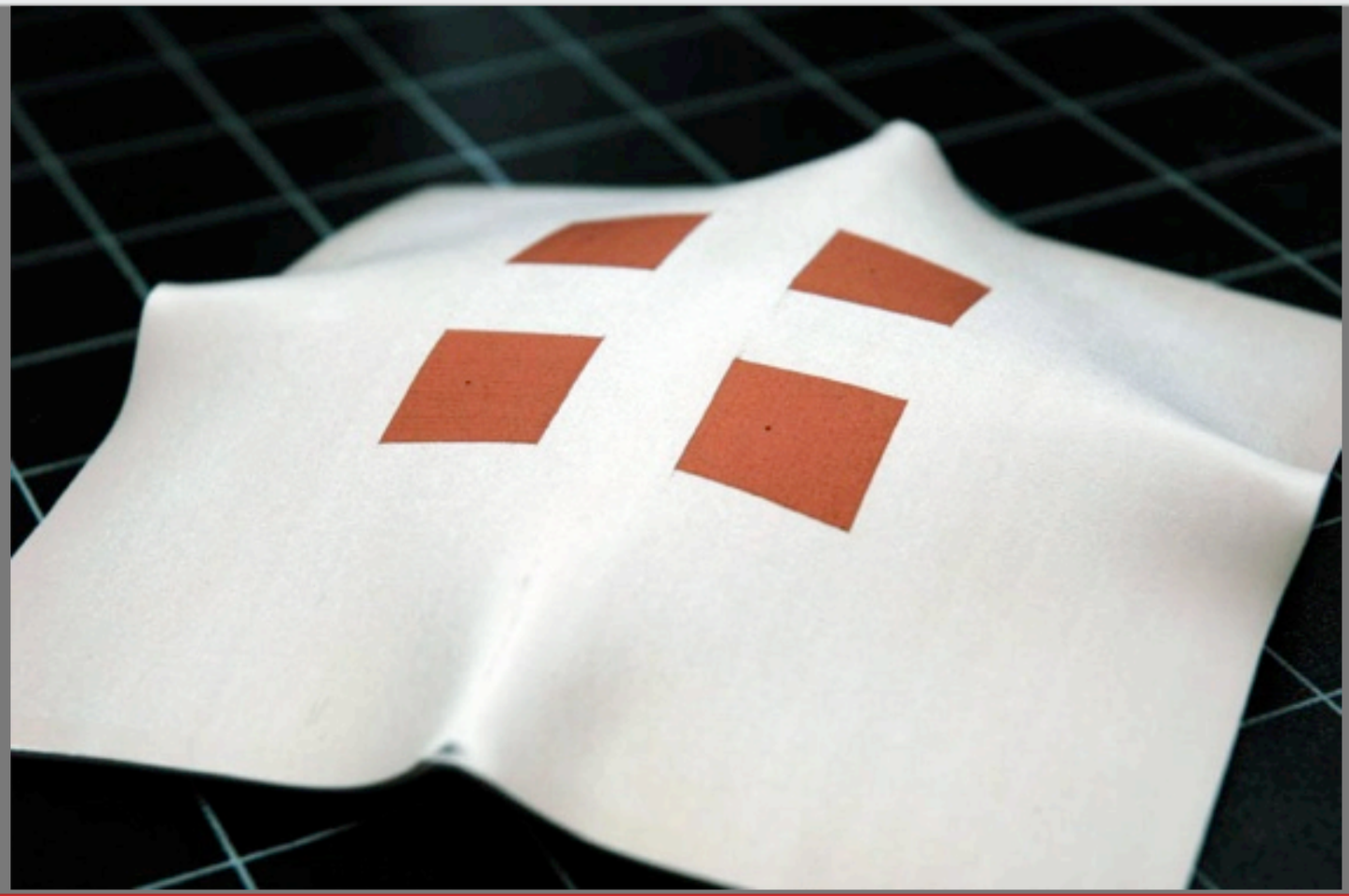
RF Characteristics

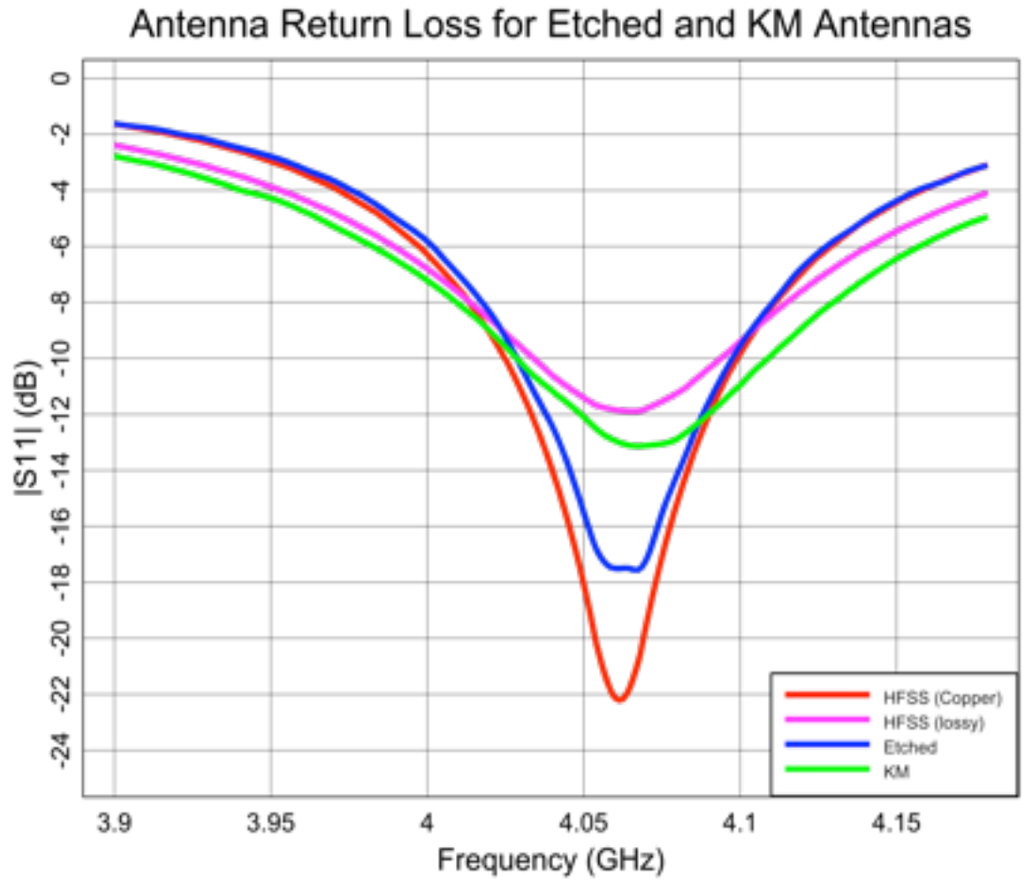
Dielectric Material	Microstrip Coating 30mills	Dielectric Constant	Loss Tangent	Q @ ~1GHz	Dielectric Attenuation Factor (dB/m)	Conductor Attenuation Factor (dB/m)
RO-3003☚	Cu-Clad	3	0.0013	340	0.16	0.25
RO-3003	KM-Cu	3	0.0013	300	0.15	0.33
Polyfon Ultem☚	Cu-Clad	3	0.003	170	0.4	0.44
Ultem-1000	KM-Cu	3	0.009	100	1.15	0.23

☚*Commercial Products*

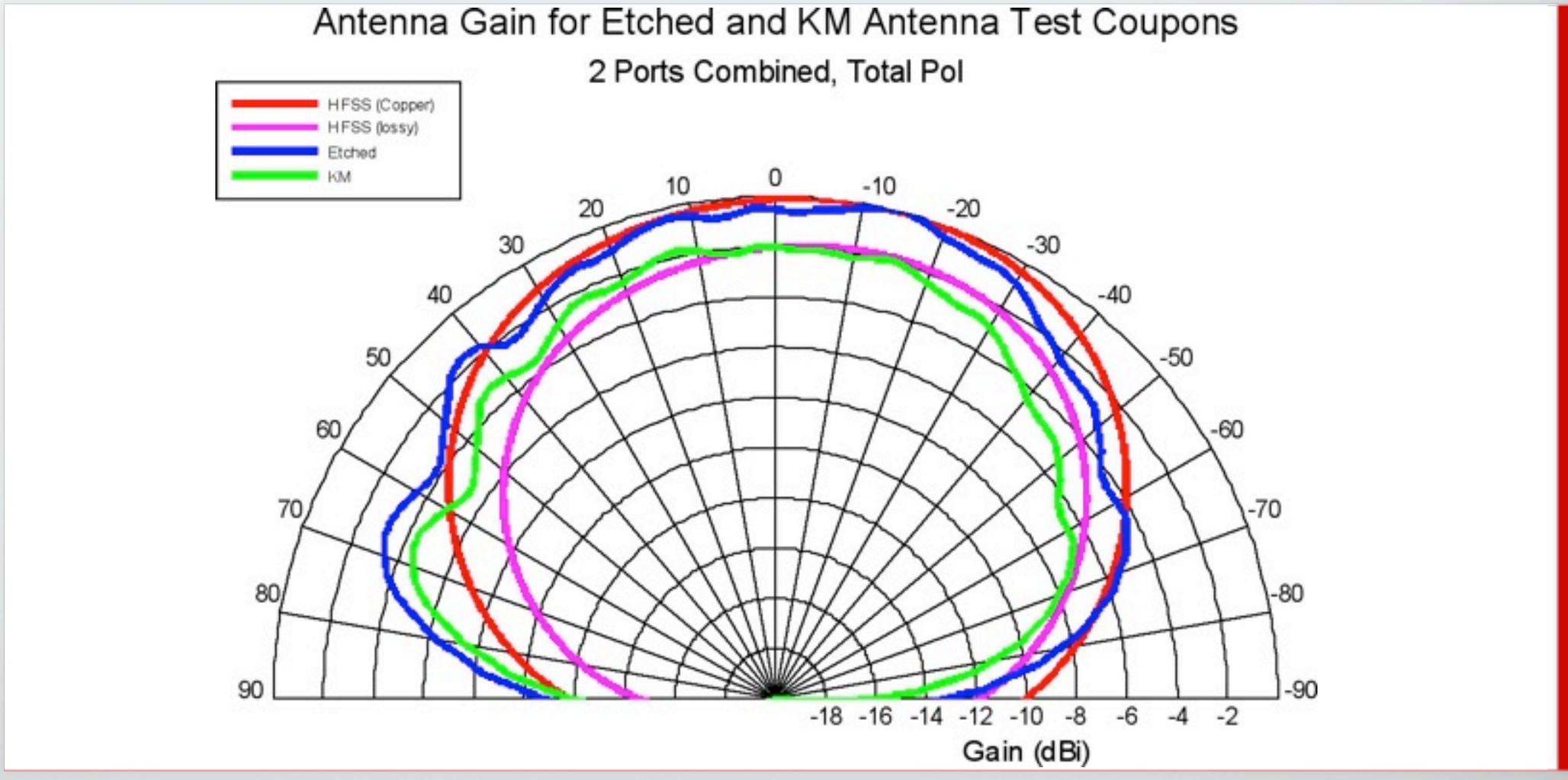
KM Deposition of Cu on RO-3003 Doubly Curved Surface

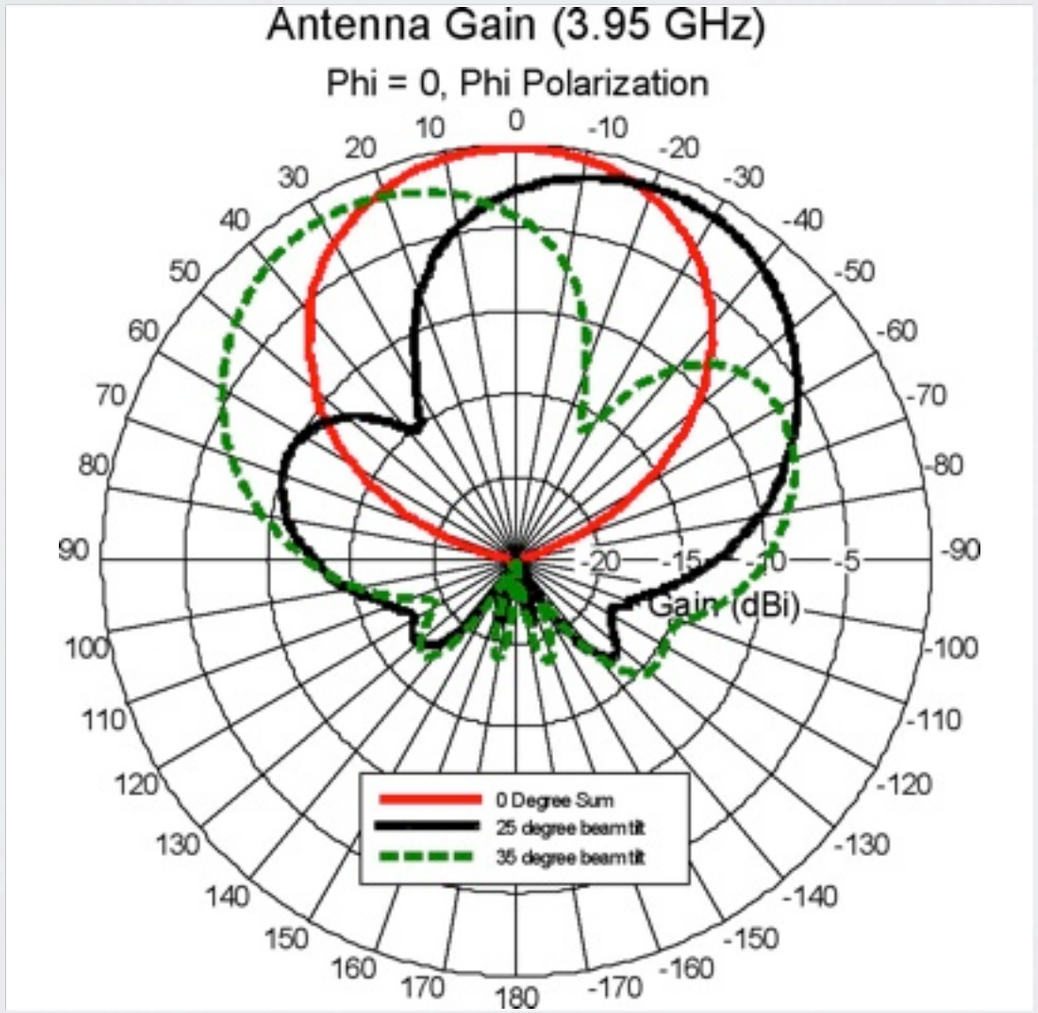


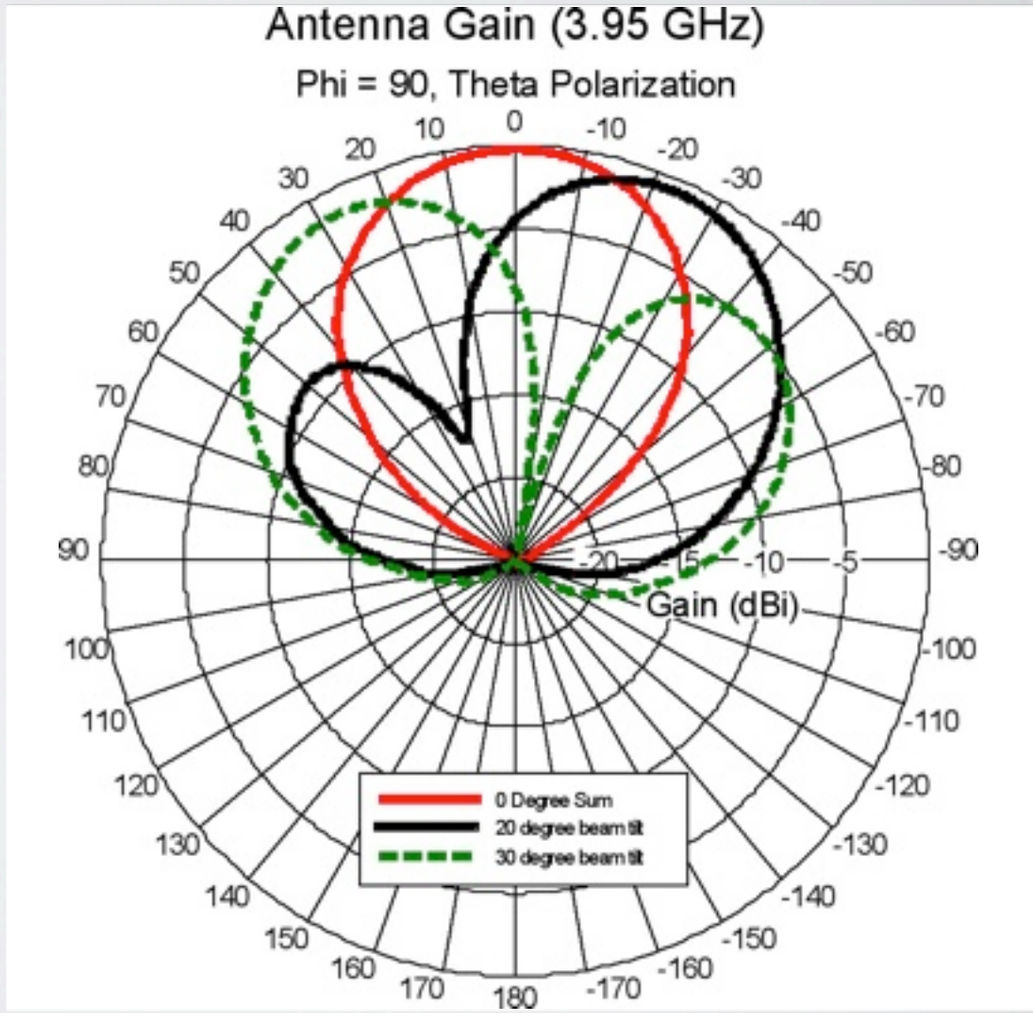
Return Loss Comparison
Etched vs. KM Antenna Elements



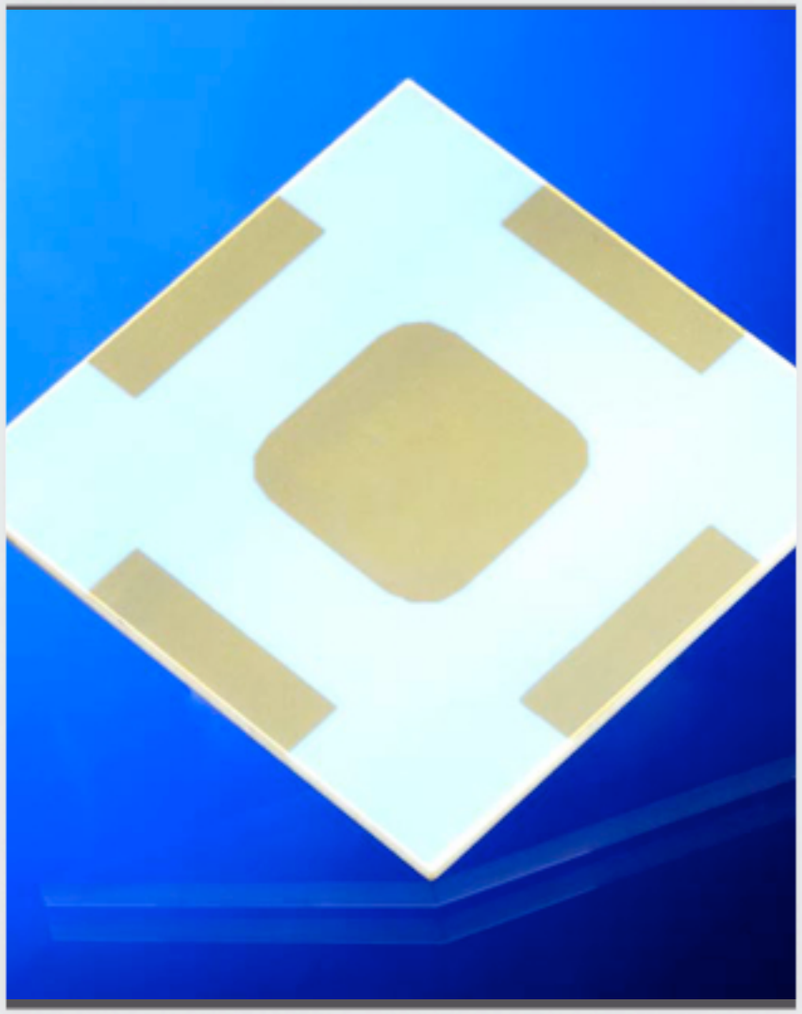
Antenna Gain
KM Cu on RO-3003

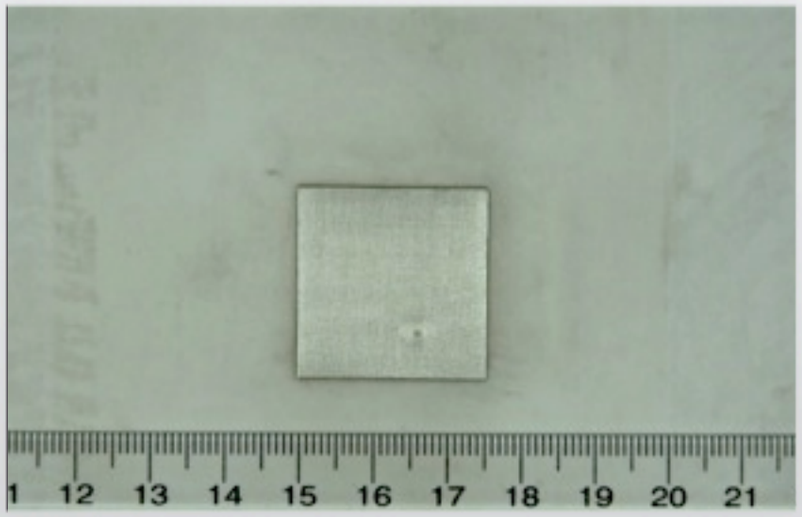






Various Antenna Patterns
4-element Time Delays



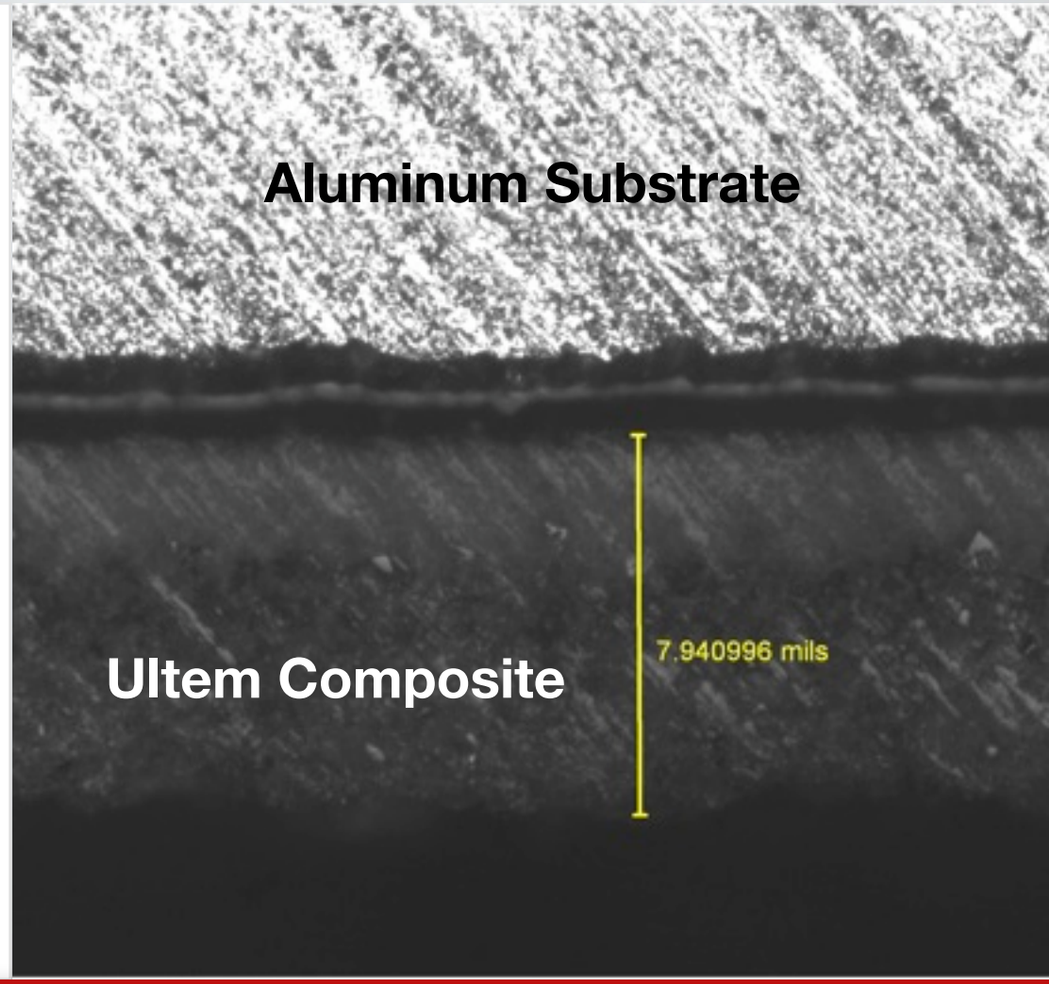


High Temperature Applications

- **RF Antenna for Missile Radomes**
  - Ag, Au, Ni on alumina dielectrics
- **Surface Acoustic Wave Devices**
  - Ag or Au on alumina dielectrics
- **Oxidation Resistant RF Antenna**
  - KM Ni coating on copper conductor
  - Turbine engine sensors/antenna

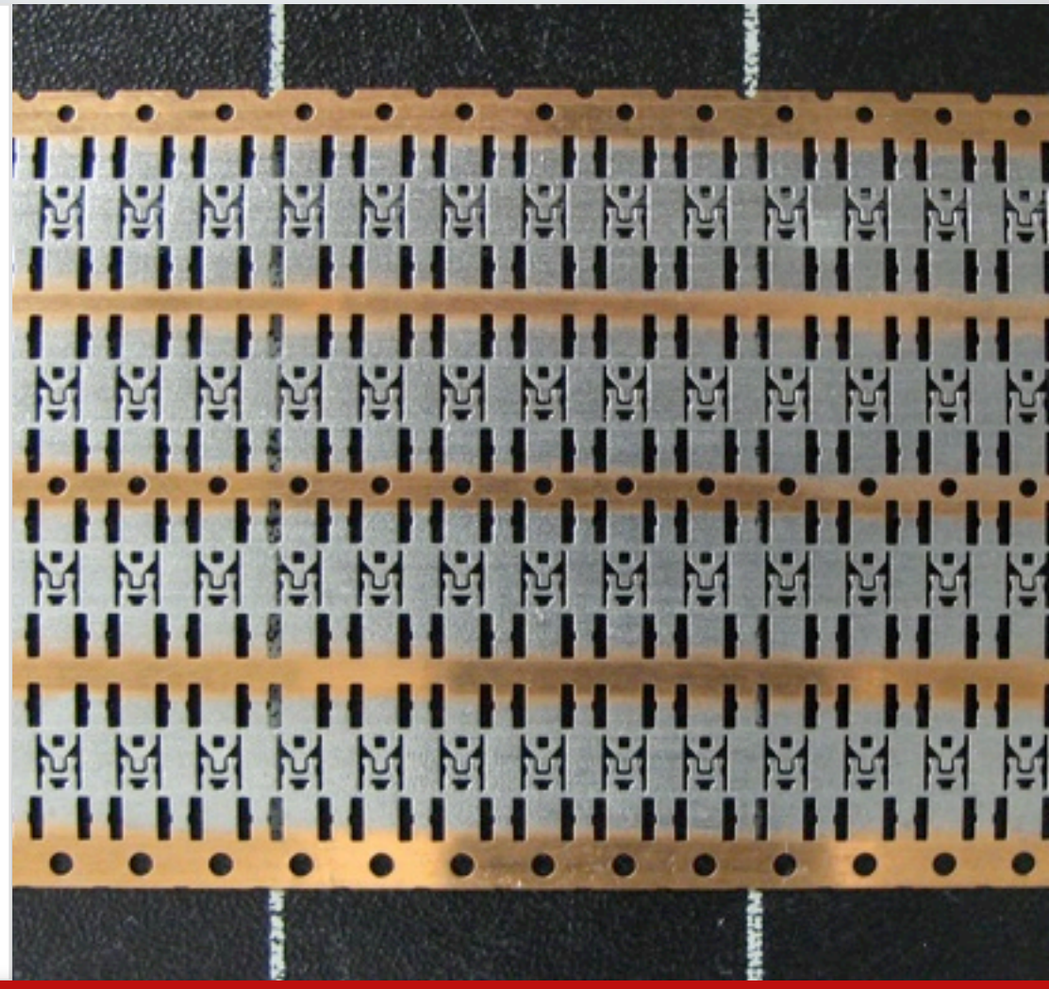
Development of KM Dielectric Composites

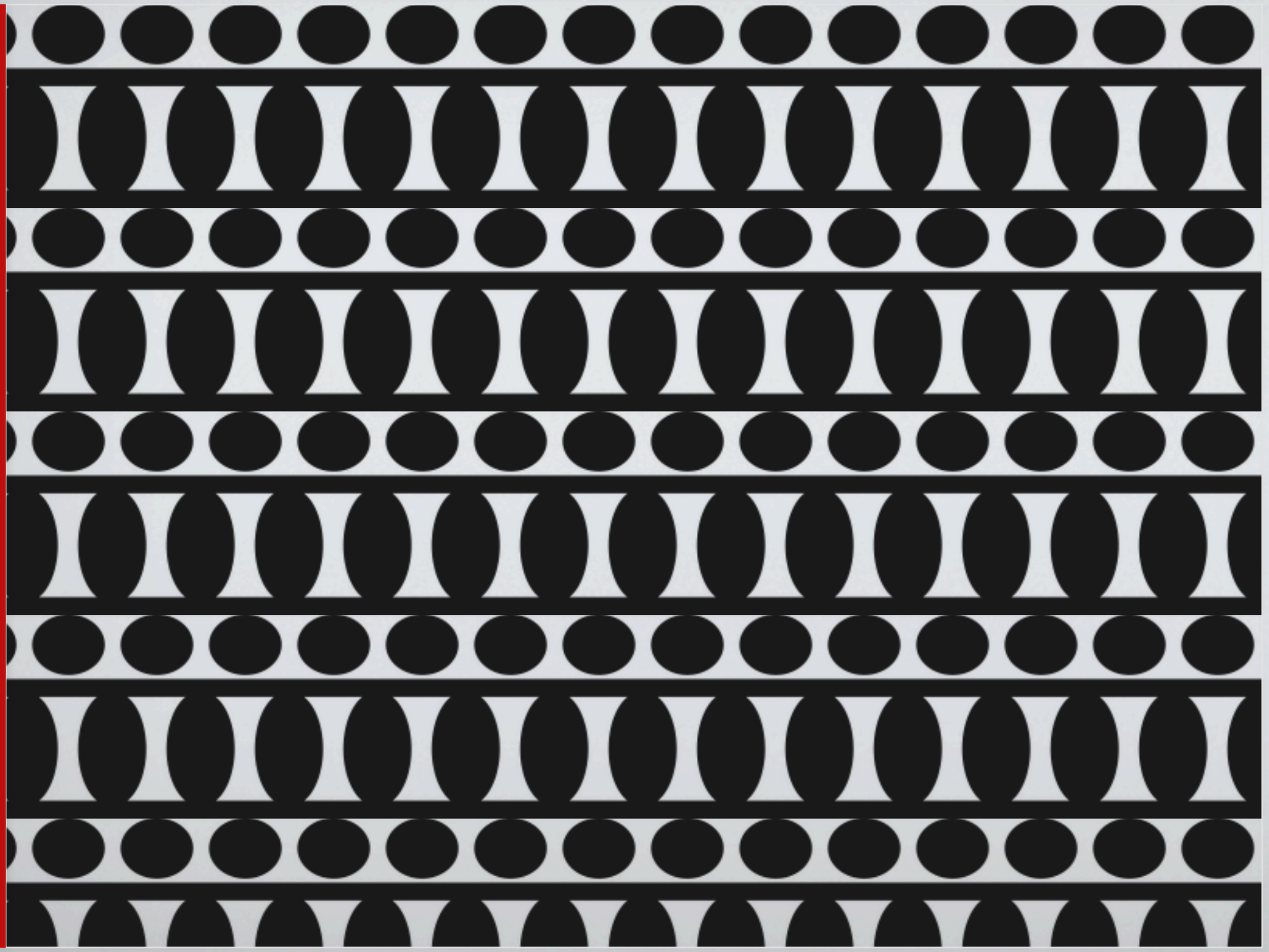
- Polymer Based Composites
  - Thermoplastics
    - Polyetherimides (Ultem)
    - Fluoroplastics - (PTFE, PVDF)
    - ABS, PVC, Acrylic
    - Polycarbonates (Lexan)
- Ceramic Loading Materials
  - Alumina, $BaTiO_3$, Fused Silica, Quartz, etc.



Electronic Interconnect Applications

- KM Copper Lead Frames
  - Ag films on Cu lead frames
  - Solder films on Cu lead frames
- Solar Panel Interconnects
  - PV grid structure





For more information, please visit our booth #319

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