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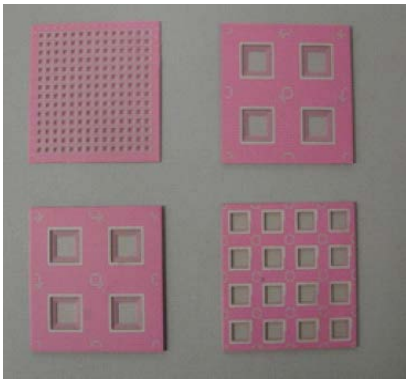
February 1, 2014 -- NATEL EMS introduces High Temperature Co-fired Ceramics (HTCC) as a viable substitute for BeO substrates.



For the past decade, NATEL has been producing various types of HTCC products for industry. Standard HTCC is seen as a lower cost version for LTCC, while Aluminum Nitride (AlN) uses identical processes but substitutes AlN tape for aluminum tape to yield better RF and heat dissipation performance. In 2013, we successfully developed a robust and repeatable process for manufacturing AlN in a manner which competes with thick film in price and offers the performance of multilayer co-fired ceramics. HTCC offers excellent mechanical stability, ease of integration into metal housings due to matched thermal co-efficient of expansion, use of non-precious metals and high thermal conductivity and solderable and wirebondable surfaces though additional plating.

We are proud to announce three new variations (data below). Design rules are available upon request.

Material Characteristics Data

Color	Black-Brown	White A	White B
Alumina Content	90%	92%	94%
Bulk Density (gm/cc)	3.6	3.5	3.5
Dielectric constant (1 MHz) (8 GHz, measured by split cavity method)	9.8 8.7	9.0 8.5	8.8 8.4
Dissipation Factor at 8 GHz ($1x10^{-3}$)	0.98	0.98	0.98
Dielectric Strength (V/m)	$1x10^{9}$	$1x10^{9}$	$1x10^{9}$
Volume Resistivity (25 C) (Ω-cm)	10^{12}	10^{12}	$>10^{12}$
Coefficient of Thermal Expansion (-55 to 300 C)	$7.0x10^{-6}$	$6.8x10^{-6}$	$6.7x10^{-6}$
Thermal Conductivity (W/mK)	15	15	15
Modulus of Rupture (MPa)	338	449	460

Tungsten Conductor Properties

Sheet Resistivity (0.001" thick unplated) ..... <12 m ohms / sq
Via fill Resistivity ..... < 5 m ohms / sq
Temp. Coefficient of resistance (-55 C to 125 C) .....3800 ppm

Plating Options

Although NATEL offers many plating options for our HTCC Composite electroplate (electrolytic) nickel / gold plating is preferred. All platable surfaces should have electrical connections. Electroless Nickel is available for solderable surfaces, and an optional gold flash improves solderability. Electroless gold plating is available for RF circuits where all surfaces cannot be tied to a bus bar.

About NATEL

NATEL is a major independent manufacturer of a wide variety of microelectronic products, providing low to high volume production for its customers. As the largest and oldest privately held EMS company in the U.S., Natel is known for high-reliability, high-quality manufacturing that delivers solutions to customers. NATEL is favorably positioned among mid-tier EMS manufacturers to “make amazing things happen.” NATEL holds and maintains industry specific certifications that include ISO 9001:2000, ISO 13485, and AS9100. Its MIL-PRF-38534 (DSCC) Class H and K certifications certify Natel’s expertise in designing and manufacturing microelectronic assemblies for space and mission-critical defense programs placing it in an elite group of aerospace industry manufacturers. NATEL, headquartered in Chatsworth, CA, has manufacturing locations in California, Nevada, Ohio, Mexico and Colorado. To learn more, visit www.NatelEMS.com or on Twitter, @Natel.

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HTCC QUICK REFERENCE DESIGN GUIDE

Green Tape	Fired Tape	Dielectric constant
HTCC 10	0.010	9.8 (1 MHz)
HTCC 5	0.005	9.8 (1 MHz)

MINIMUM THICKNESS OF ANY PORTION OF HTCC 0.020" (~ 20 MILS)

TYPICAL CAMBER 0.002" /IN /IN (2 MILS) Free Sintered
0.001"/IN /IN (1 Mil) Flat Fired

CONDUCTOR LINE WIDTH AND SPACING – PREFERRED 6 TO 10

Conductor to edge of Substrate/cavity clearance 10 mils (low vol), 15 ml (high vol) for surface, buried, RF grounds. Minimum dimensions – 5 mils (condu to edge)

Ground and power planes Large exposed planes may be solid. Buried planes should be gridded whenever possible. Gridded planes have 10 mil lines with 15 to 20 mil openings (10 mil min). Areas on ground planes may be solid to provide shielding. Feed through vias / pads on buried plane layers should have 15- 20 mil (8 min) isolation clearance between feed through and the plane

Via 6 to 10 mils. 4 mil via in rare cases

Catch pad 1 to 4 mil bigger on all four sides. Catch pads may be excluded from Rf transition vias.

Via to via spacing RF Vias 2.5 to 3X the via size (thermal and RF via excluded from this criteria designs requiring high frequency lines and controlled impedance lines may require buried coaxial type shielding which is accomplished by placing vias parallel to the controlled lines through out the shielded cross sectional area. Rf vias may be placed as close as 2 mils apart as long as they are electrically common to each other. RF vias may also be stacked if they maintain 2 via dia pitch minimum.

Thermal via 10 mil via with 10 mil spacing

Brazing Brazing Technique is similar to LTCC where 80/20 Au/SN solder is used. GPO, GPPO, G3PO or G4PO connectors can be attached.

Hardware Heat sinks made with Cu-Mo, Cu-Mo-Cu, AlSiC may be used.