

C12 Advanced Technologies Application Notes: LTCC Carbon Tape (TCS-CARB-1)

Description

C12 Advanced Technologies' **LTCC Carbon Tapes** are thin, flexible tapes made of specially processed, high purity carbon. **LTCC Carbon Tapes** are used to form in-situ channels, cavities, and MEMs structures in LTCC laminates and other multilayer components. **LTCC Carbon Tapes** are designed to be compatible with all major commercial LTCC tape and screen printable systems. "Thermally fugitive" **LTCC Carbon Tapes** are engineered to burn out cleanly in air atmospheres, and begin to rapidly sublime at 600C as the ceramic matrix sinters, leaving behind well-defined features such as cavities and channels. **LTCC Carbon Tapes** create precise, stress-free structures unlike conventional fugitive materials, such as waxes and polymers, which often leave residue and result in stress related distortion. **LTCC Carbon Tapes** can also be a cost effective alternative to using removable inserts such as platinum or latex to create structural features. **LTCC Carbon Tapes** do not smudge, and are easily punched or cut into complex shapes with simple tools or with low-power laser trimmers.

Benefits

- Forms in-situ buried channels, cavities, and MEMs structures in LTCC and other multilayer composites.
- Prevents deformation during high pressure lamination of multilayer structures.
- Prevents slumping during firing.
- Contains high purity carbon which burns out cleanly in air atmospheres – sublimates directly without causing stress on green parts.
- Cost effective substitute for removable inserts (e.g. latex, platinum, etc.)
- Does not require complex lamination and firing cycles that are necessary when using other fugitive materials such as wax or polymeric materials.
- Compatible with all major commercial LTCC tape and screen printable systems.

Cutting and Punching Methods

LTCC Carbon Tapes can be punched, sliced, laser cut, machined, or hand cut in order to meet specific design requirements. TCS-CARB-1 is provided with a 0.003

inch Mylar release backing, which should be removed prior to punching or cutting.

Lamination

Carbon Tapes can be laminated (uniaxial or isostatic) in order to achieve a desired thickness. Lamination of Carbon Tapes can be completed prior to insertion, or during co-lamination with ceramic tapes in accordance with conventional LTCC procedures, (typically 70C for 10 min at a pressure of 3000 psi). Specific lamination parameters will vary depending on final laminate thickness and the ceramic tape system being used.

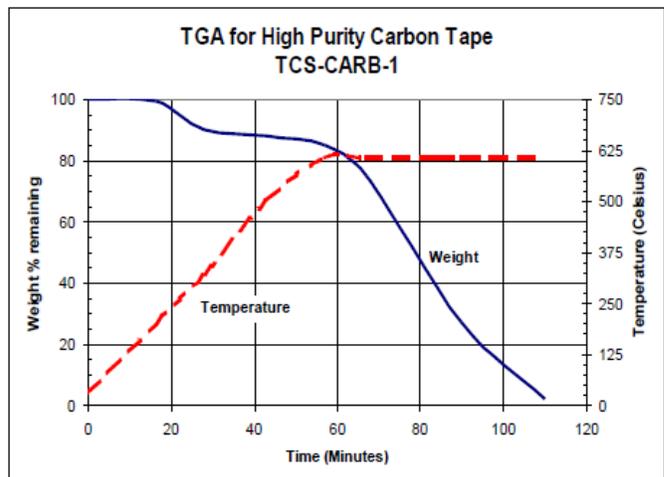


Fig. 1. After an initial 60 min. ramp up from room temperature, the high purity LTCC Carbon Tapes show rapid sublimation when the temperature is held at 600C during TGA analysis.

Firing

Carbon Tapes must be fired in an oxygen atmosphere in order for sublimation to occur. Binder burn out of the Carbon Tapes occurs at approximately 325-450C, and will not interfere with the binder burn out of most commercially available LTCC tape systems. Rapid sublimation of the high purity Carbon Tapes occurs at temperatures approaching 600C, as shown in Figure 1. Complete sublimation will depend on heating rate, time, maximum temperature, volume of carbon, and the oxygen content of the furnace atmosphere. The firing schedule in Figure 2 can be used to create distortion free microchannels and buried cavities in LTCC multilayers. The firing profile consists of 3 steps; the first plateau at 350C for 60 min is used to burn out organic binder components, the next plateau at 710C

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for 60 min allows all residual carbon to completely burn out just before LTCC pore closure, and finally, viscous sintering of the LTCC multilayer takes place during the the last plateau at 850C which is held for about 15 min.

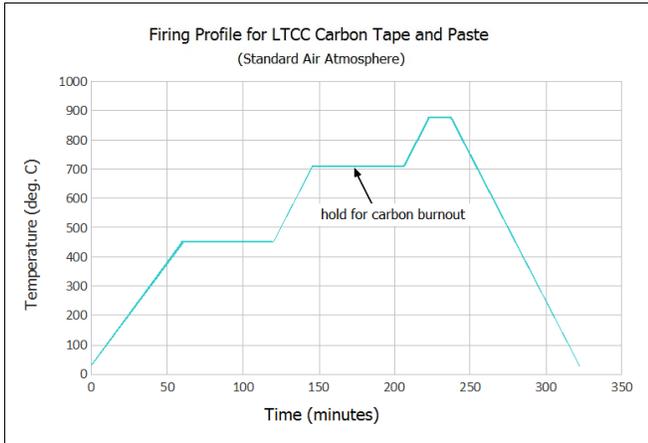


Figure 2. Recommended firing schedule for creating distortion free microchannels and buried cavities in LTCC multilayers.

Clean-up

Excess Carbon Tape can be removed from equipment surfaces with isopropyl alcohol (IPA) or ethanol. Follow appropriate cleaning procedures for equipment used to process Carbon Tape. Carbon Tapes are not likely to be hazardous by skin contact due to low levels of potential irritants, however user should avoid intimate skin contact. Wash thoroughly with mild soap and water. Seek medical attention if irritation develops.

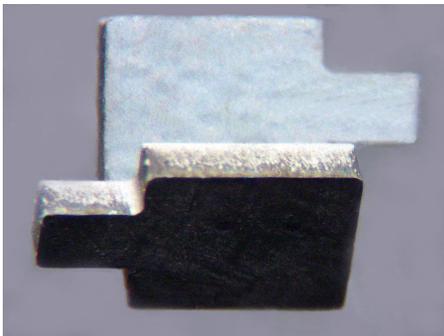


Figure 3. LTCC Carbon Tapes can be easily laminated and laser cut to precise tolerances. The Carbon Tape inserts shown above are 2mm wide and 0.076mm thick.

Storage and Shelf Life

Carbon Tapes in sheet and roll form should be stored in tightly sealed boxes or bags in a clean, dry atmosphere at room temperature. Carbon Tapes can be stored for at least 3 years.

Safety and Handling

When working with Carbon Tapes, follow appropriate health and safety regulations contained in Carbon Tape MSDS. The following precautions should be taken when handling the carbon tapes;

Avoid skin contact and use appropriate personal protective equipment such as gloves.

Wash thoroughly with soap and water after handling. This product is not for human consumption.

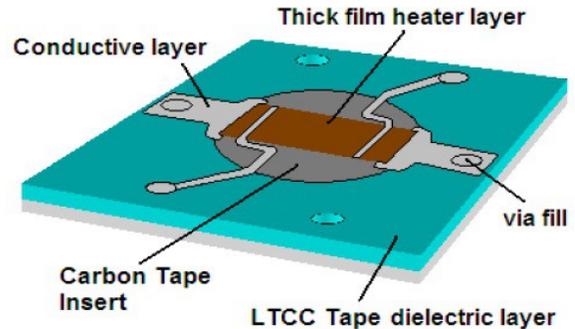


Figure 4. Thermal isolation cavity formed with LTCC Carbon Tape insert.



Cross section of buried microchannels in LTCC laminate (approx. 40um and 130um)



Cross section of embedded microchannel in LTCC formed with 5 mil Carbon Tape.



Embedded microchannel in LTCC formed with screen printed Carbon Paste, 1.5 mils thick.

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