



ComEd
“Development of competences of educational staff by integrating operational tasks into measures of vocational training and further education”

Exploration task
“Comparison of Methods of Innerlayer Cavities Realization in Low Temperature Cofired Ceramics”

(Stand: 09/2010)

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Contents

1. Subject of exploration and work order	1
2. Background information	2
3. Utilities for the exploration	2
4. Results of the exploration.....	2
5. Identified problems, needs for improvement	2
6. Attachments	2

1. Subject of exploration and work order

Low Temperature Cofired Ceramics (LTCC) is progressive evolving ceramic material in the field of electrotechnical engineering. Its advantages are primarily low temperature of firing (under 1000°C) and flexibility in green (unfired) state, that facilitate realize a planar, a shaped multi-layers structures, a manifold shaped cavities, a channels, an embedded structures and other ones.

The cavities can be situated on the top of structure (toplayer cavities) or can be embedded in the structure (innerlayer cavities). Sagging of layers (over and under innerlayer cavity) during processing of LTCC ceramic with innerlayer cavities due to deformation during lamination or due to thermal tension at glass transition temperature during sintering is the common problem.

Please depict your collected information about methods of innerlayer cavities realization in a Power-Point presentation.

- Give some information about LTCC technology.
- Please, describe the principles of making of toplayer and innerlayer cavities in LTCC structure.
- What is the major step which determines quality of innerlayer cavities? Describe this step in more detail.
- Compare of methods of innerlayer cavities realization. How are their advantages and disadvantages?
- Where is the innerlayer cavities application?

2. Background information

- LTCC technology.
- Principle of lamination.

3. Utilities for the exploration

- Books.
- Accessible articles on internet.

4. Results of the exploration

A PowerPoint presentation entertaining the LTCC technology, technology of making innerlayer cavities in LTCC structures and comparison of methods of innerlayer cavities realization was worked-out.

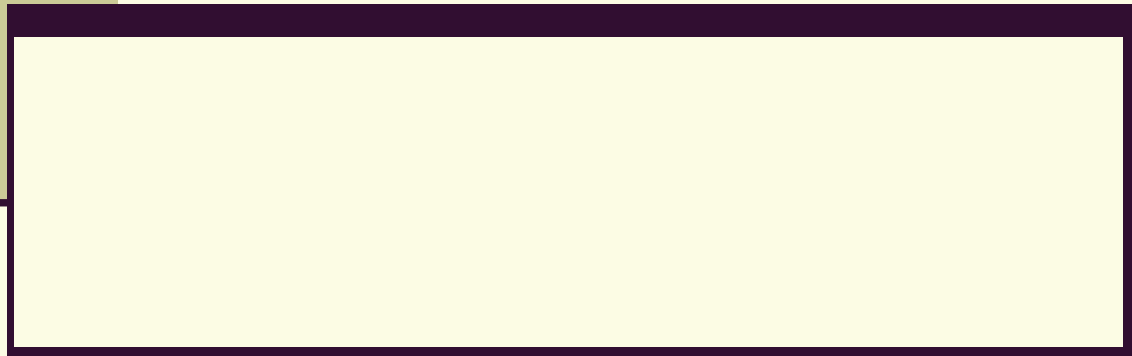
5. Identified problems, needs for improvement

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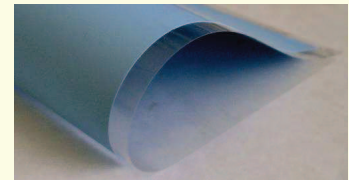
6. Attachments

PowerPoint presentation.

Comparison of Methods of Innerlayer Cavities Realisation in LTCC



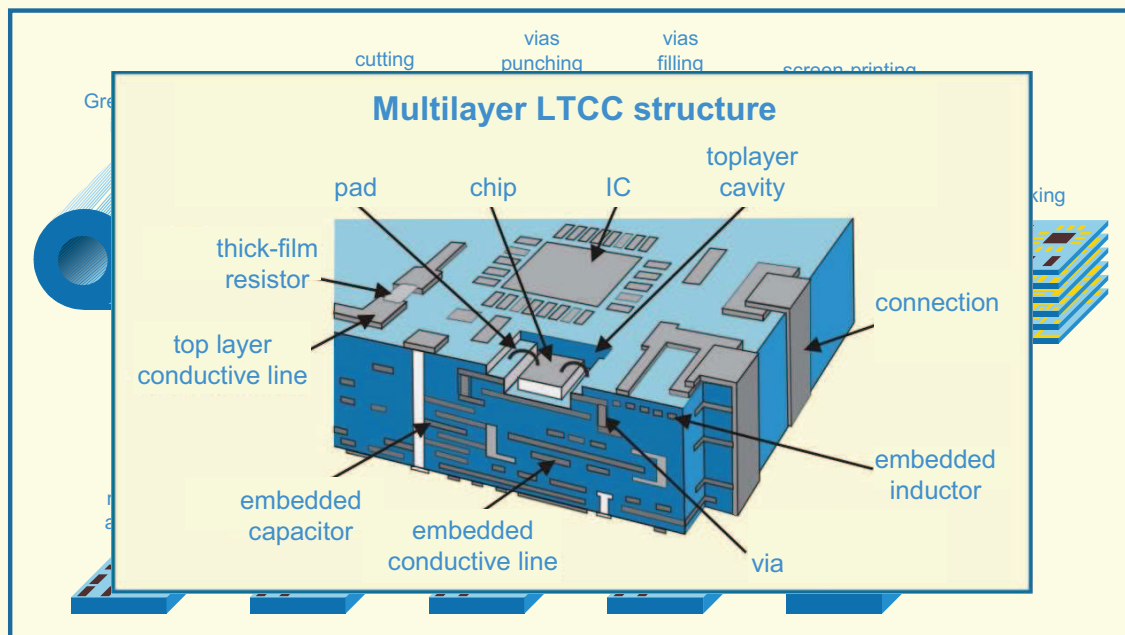
LTCC ceramic



- LTCC (Low Temperature Cofired Ceramic):
 - Low Temperature – temperature of firing is under 900°C,
 - Cofired – laminated layers of ceramic with thick-film passive components and conductive interconnections are fired together in one step,
 - Glass/Ceramic material:
 - in green (un-fired) state is flexible (~15% organic + ~85% inorganic),
 - after firing – rigid ceramic material.

Green Tape™ 951							
Shrinkage	ϵ_r [-]	R_i [Ω]	$tg\delta$ [-]	λ [W/m.K]	R_{mo} [MPa]	E [GPa]	α_T [ppm/°C]
x-y: 13% \pm 0.3% z: 15% \pm 0.5%	7.8	$> 1 \times 10^{12}$	0.0015	3.0	320	152	5.8

Technological steps of LTCC processing



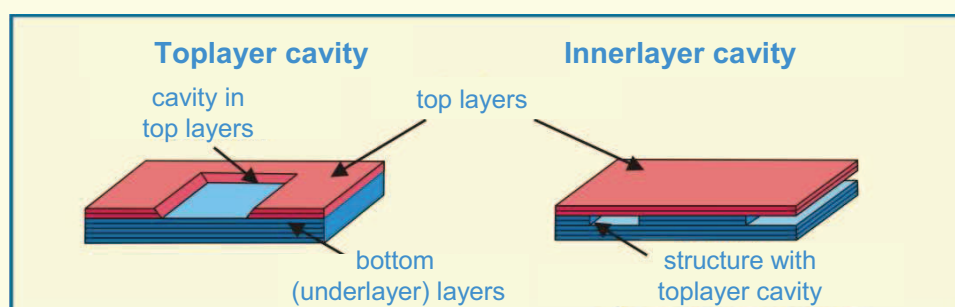
Toplayer and Innerlayer cavities

■ Toplayer cavities:

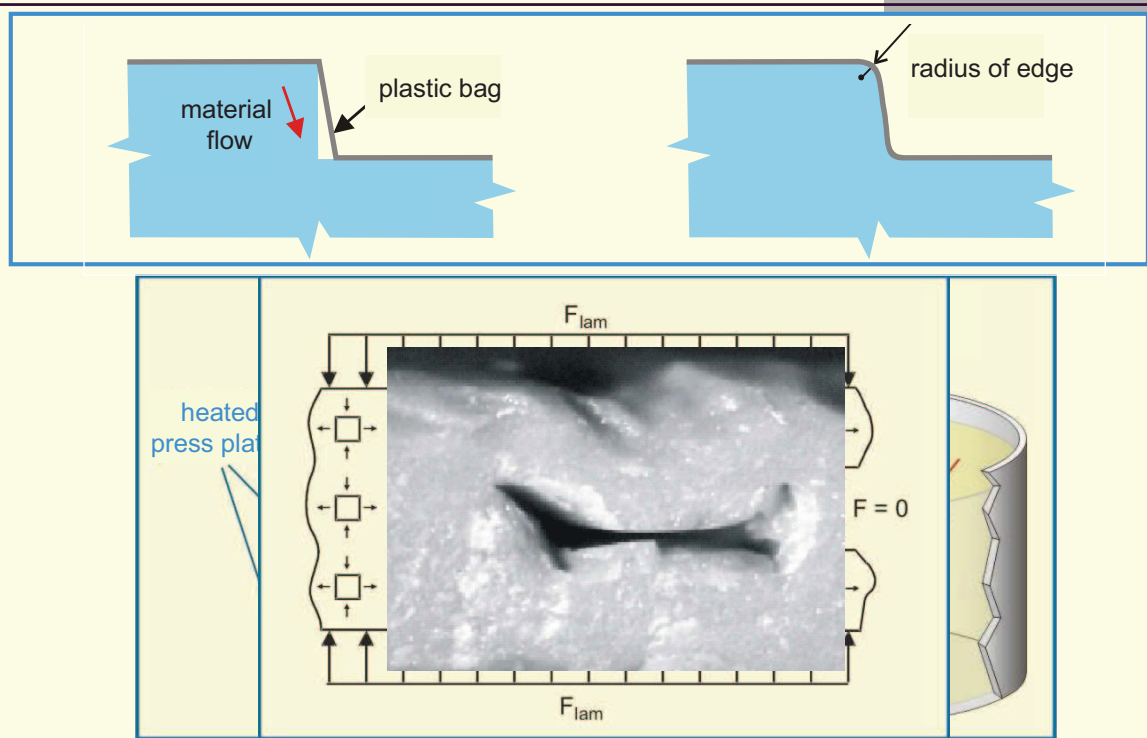
- over the bottom (underlayer) layers without aperture are located top layers with cut aperture,
- application – mainly for chip mounting on the multilayer structures, carriers of sensors etc.

■ Innerlayer cavities:

- over the structure with toplayer cavity are stacked another layers without aperture,
- application – channels or capillaries for cooling, microfluidic or sensor applications.

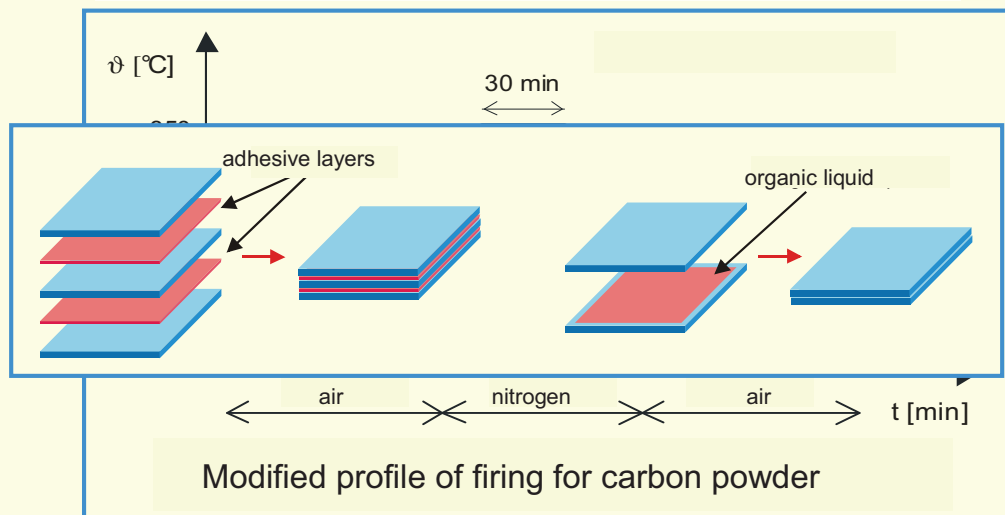


Thermocompress lamination



Methods of cavities production in LTCC ceramics

- Methods of cavities production in LTCC ceramics:
 - multi-stage lamination,
 - lamination with carbon powder,
 - lamination with CLPL (Cold Low Pressure Lamination).

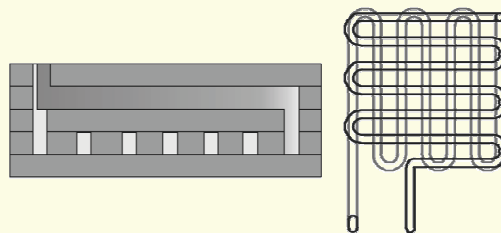


Comparison of Methods of Cavities Realisation

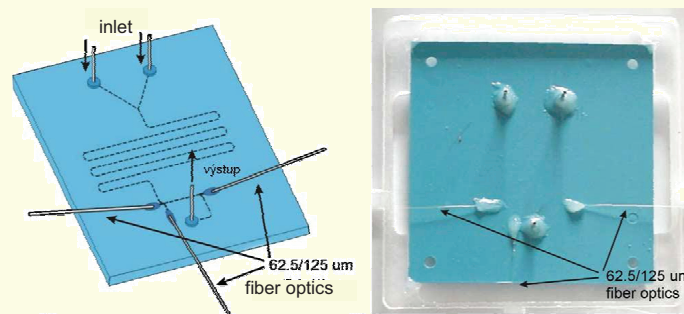
- Comparison of Methods:
 - multi-stage lamination:
 - + simply methods without additional materials and equipments,
 - - usable only for cavities with small width and sufficient number of layers over the cavity,
 - lamination with carbon powder:
 - + better planarity and clearness of cavities,
 - + modification of firing profile allows to prevent sagging of layers over the cavity during firing,
 - - more difficult application carbon filler into the cavities,
 - CLPL lamination:
 - + suitable methods for cavities realisation,
 - - possible sagging of layers over the bigger cavities during firing.

Innerlayer cavities and their application

- Cooling

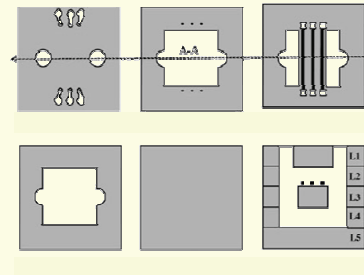
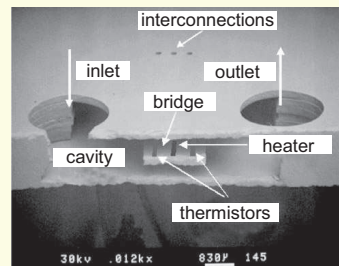


- Microfluidic application



Innerlayer cavities and their application

■ Flowmeter



■ Microvalves

