



Dickschicht-Pastenentwicklung für die Sensorik, die Leistungselektronik und die Hochfrequenztechnik

80. Treffen SAET, Fraunhofer IKTS, Dresden

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Ceramic thick-film and multilayer technology

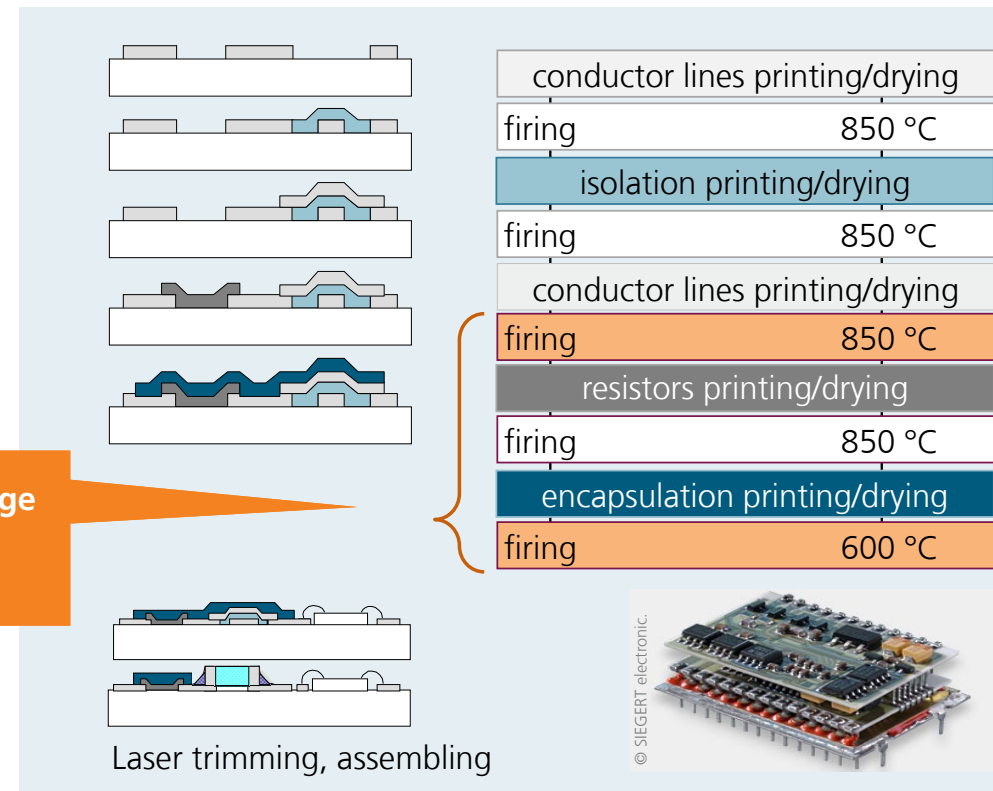
Process flow thick-film technology

■ **Sequential film** printing, drying, firing (on fired substrate)

■ **Different functional pastes/inks**

- Metallization – Ag, AgPd, AgPt, Au, Pt, Cu (contact pads, conductor lines; solder able, plate able, bond able)
- Resistors – different decades (1 Ohm .. 1 MOhm/sq)
- Glass layers
 - Type 1 – 850 °C isolation, overcrossing
 - Type 2 – 600 °C encapsulation

Volume shrinkage
(multilayer)
35–50 %



How to make an ink/paste



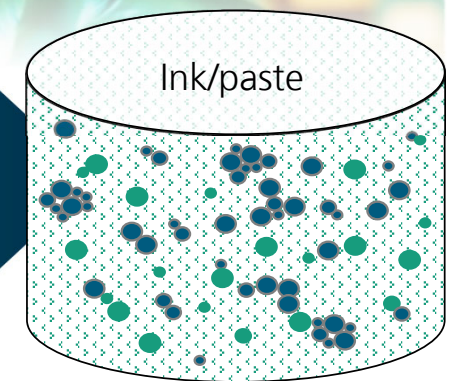
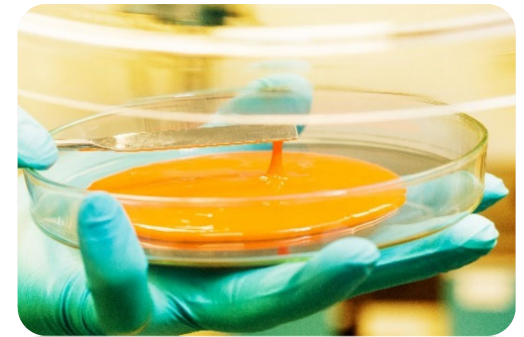
Glass, inorganics, additives



Solvent, polymer

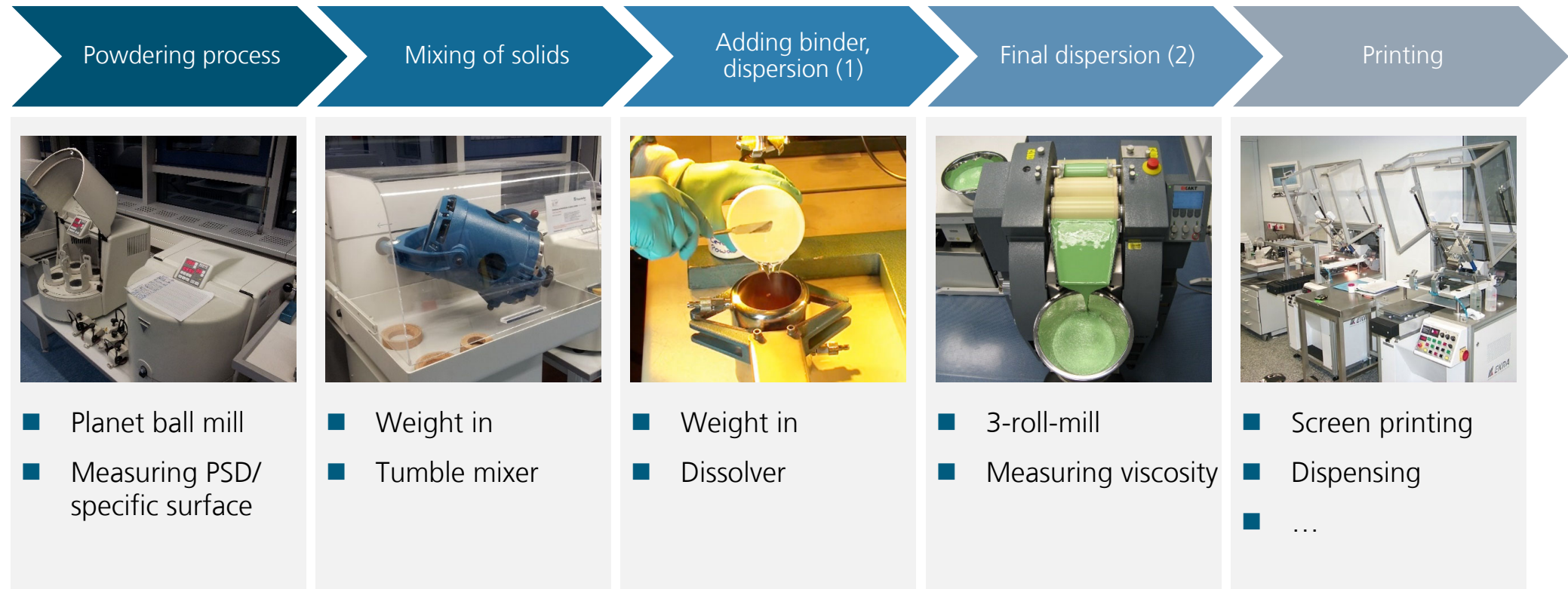


Mixing, dispersing



How to make an ink/paste

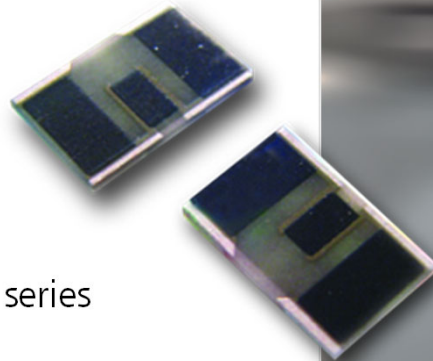
Functional paste manufacturing process



Main Research Topic **Power electronics**

Thick-film paste system for AlN-ceramics

- **Topic: Unique paste composition for AlN-Substrates**
(high thermal conductivity (180-200 W/m·K, CTE matches Si) **provided by IKTS** (DIN/ISO 9000 certified))
- **Resistor** paste series
 - **FK 96XX** (RuO₂), **FK 99XX** (AgPd)
- **Metallization** paste series
 - **FK 11XX/ 12XX** (AgPd)
 - **FK 10XX** (AgPt)
- **Glass encapsulation and marker** paste series
 - **FK 40XX**
- **Preliminary research**
 - **High ohmic resistors**



Paste production: 48 kg batch
FK 4027 encapsulation paste
@ IKTS clean room (3-roll-mill)



Klick for further [information](#)



Application examples

Lead-free pastes for AlN substrates

■ Goal

- TFR, metallization and encapsulation pastes for AlN (standard pastes (alumina) not applicable because of strong interactions glass/AlN)

■ Approach

- Adapted glasses (no chemical interactions, suited glass viscosity)

■ AlN - advantages

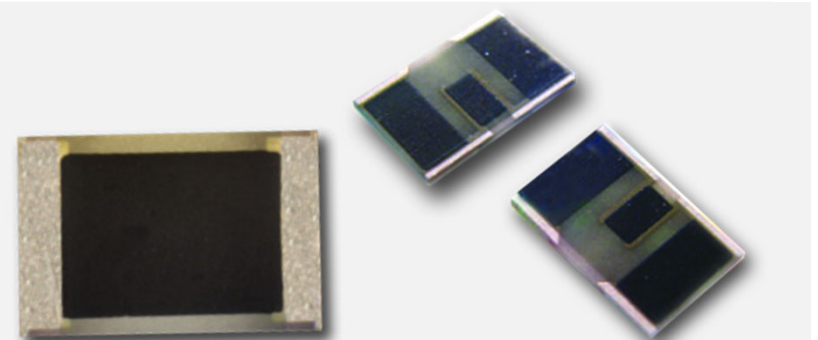
- High thermal conductivity: 180...200 W/m·K
- CTE: $4.8 \cdot 10^{-6}$ 1/K

■ High dielectric strength > 12 kV/mm

- Application fields
- High power TFR
- Attenuators



Conductive chains (3D network)



Source: <https://ims-resistors.com/>

Current research topics

Lead-free pastes for AlN substrates

■ Result: AlN compatible paste system

Paste	Metal	R sq/mOhm/sq	Application
FK 1205	AgPd	< 25	R termination
FK 1220	AgPd	< 25	Acid stable
FK 1164	AgPd	< 25	Via paste
FK 1071	AgPt	< 6	Low resistance
FK 1282	AgPt	< 35	De-alloy stable

Paste	Cond. Phase	R sq/Ohm/sq	TCR/ppm/K
FK 9821m	AgPd	0.1	± 75
FK 9831m	AgPd	1	± 75
FK9611	RuO ₂	10	± 100
FK9615	RuO ₂	50	± 100
FK9621	RuO ₂	100	± 100
FK9631	RuO ₂	1.000	± 100

Resistor, conductor, encapsulation and heater pastes for AlN-ceramics, raw materials.

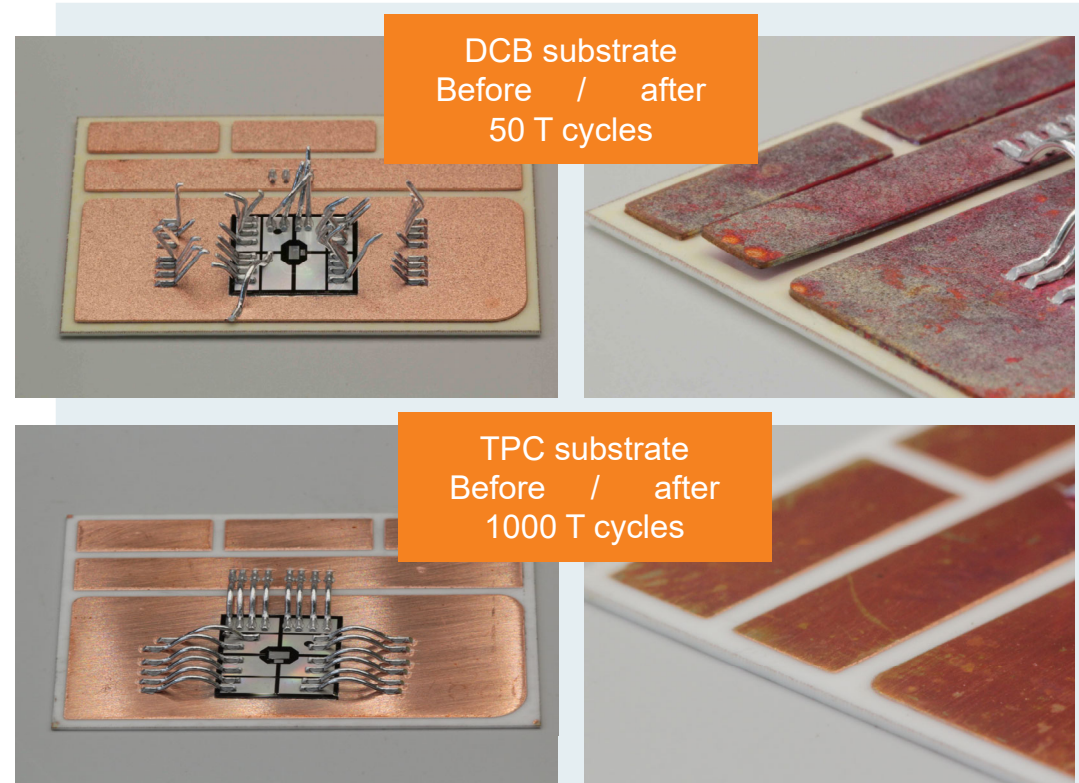
[Further information/catalogue](#)



Main Research Topic **Base metal pastes**

Fraunhofer funded internal project »**TPC LE** - Reliability of thick-printed copper on alumina substrates«

- **Topic:** Reliability of thick-printed copper metallisation vs. DCB (thermal/ power cycling)
- **Project partners:** Fraunhofer IISB, IKTS
- **Objectives:** Reliability comparison between DCB-, AMB- and TPC-metallized ceramic circuits
- **Thermal cycling**
 - Temperatures: -40 ... +125 °C
 - Cycle time < 30 s
 - Dwell time > 15 min
- **Paste development**
 - **Metallization:** Cu, CuNi
 - **Resistor:** NiCr (under development)
 - **Encapsulation:** glass (under development)



Current research topics

Base metal pastes

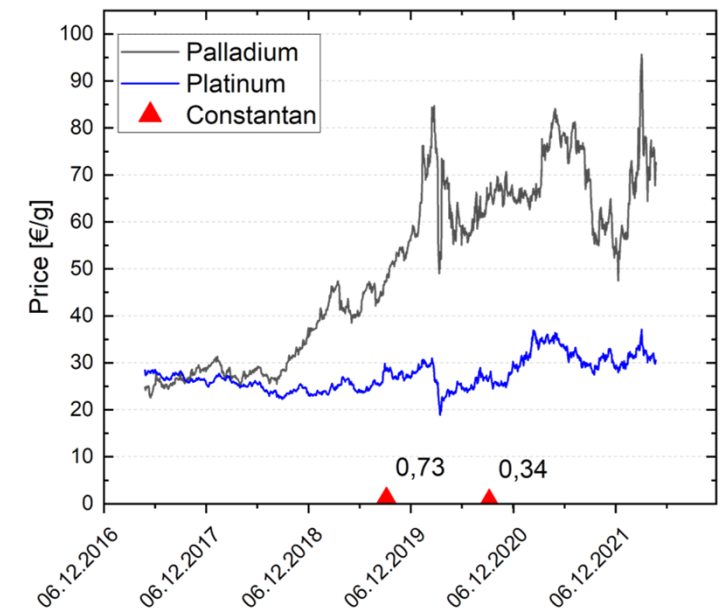
■ CuNi(Mn) pastes

■ Favorable properties

- High electrical conductivity
- Temperature coefficient of resistance close to zero
- Temperature **stability up to 600°C**
- **low metal price**

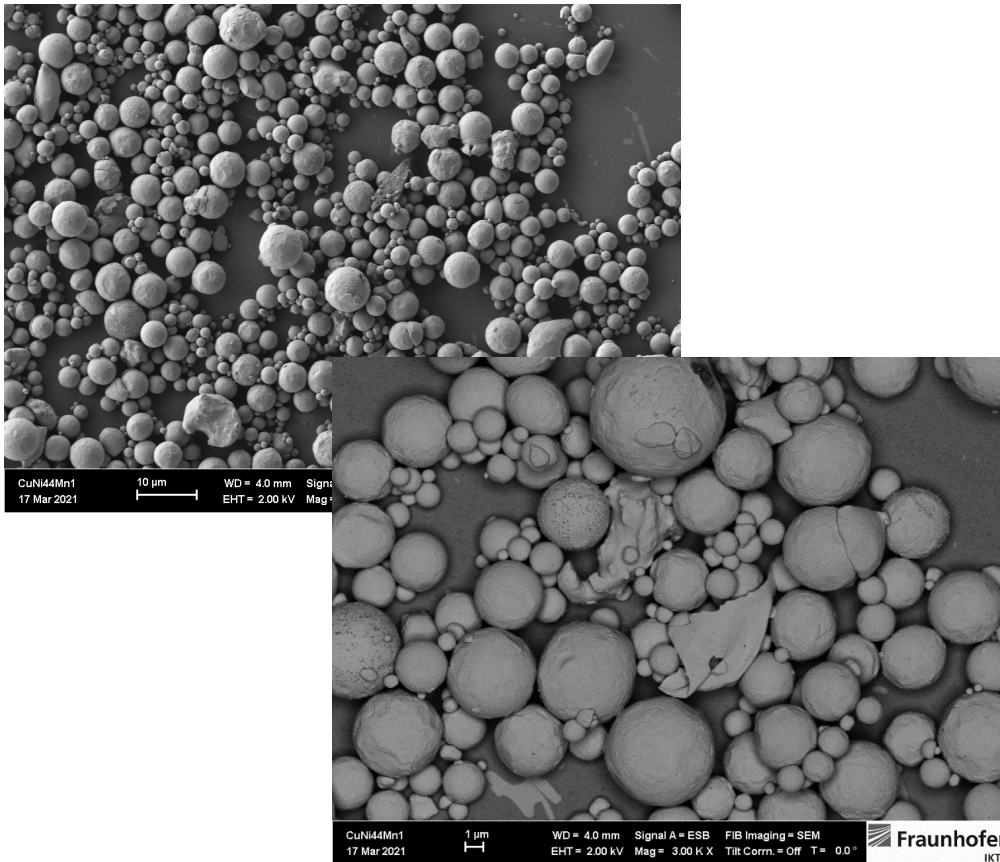


And still, there is **only one commercial paste supplier** with a Constantan paste.



Current research topics

Base metal pastes



■ Atomized Constantan powder (Cu55Ni44Mn1)

- Atomization atmosphere: Argon
- Grain size roughly 15 µm
- Classification to PSD

$$d_{10} = 3.1 \mu\text{m}$$

$$d_{50} = 7.3 \mu\text{m}$$

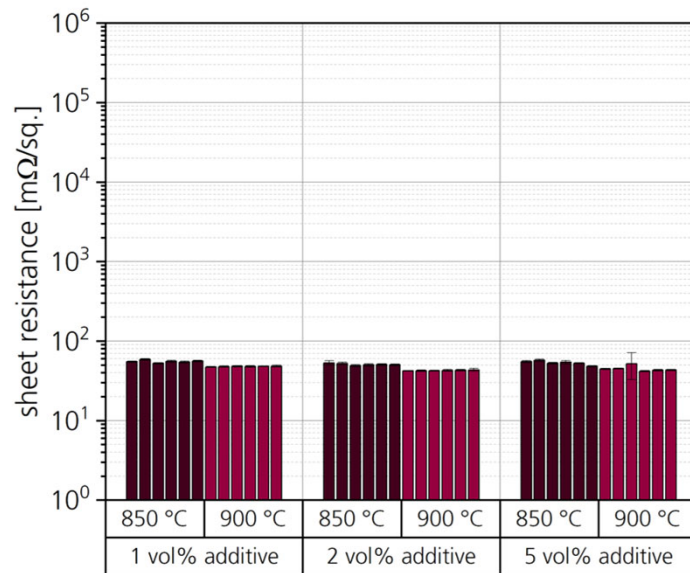
$$d_{90} = 13.2 \mu\text{m}$$

■ Glass powders ($\text{SiO}_2\text{-B}_2\text{O}_3\text{-Al}_2\text{O}_3$)

- At IKTS melted glasses
- Stepwise grinding to $d_{50} \sim 2.4 \mu\text{m}$

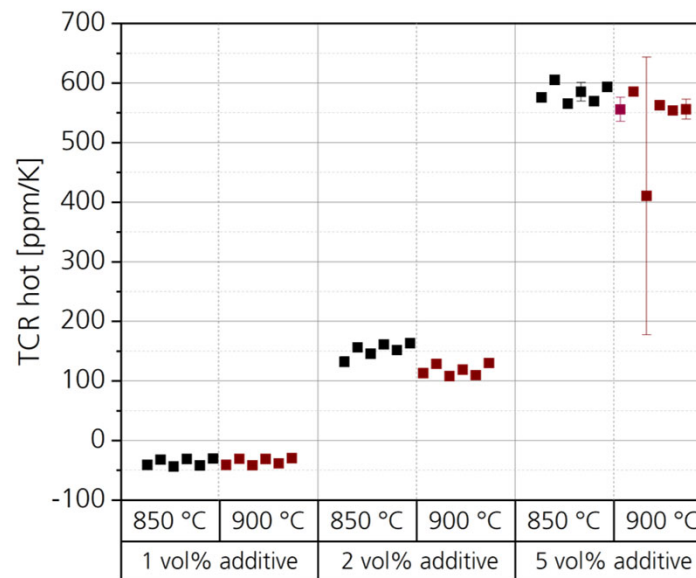
Constantan pastes

Sheet resistance and TCR



Sheet resistance

- Sheet resistivities in the range of 50-60 mΩ/sq
 - Independent of firing temperature or
 - oxygen scavenger content



Temperature coefficient of resistance

- TCR in the range of -50 up to 600 ppm/K
 - Dependant on oxygen scavenger content

Current research topics

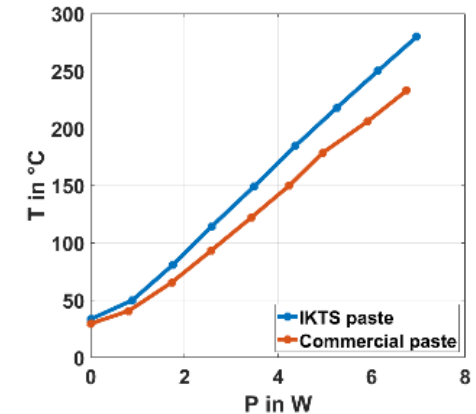
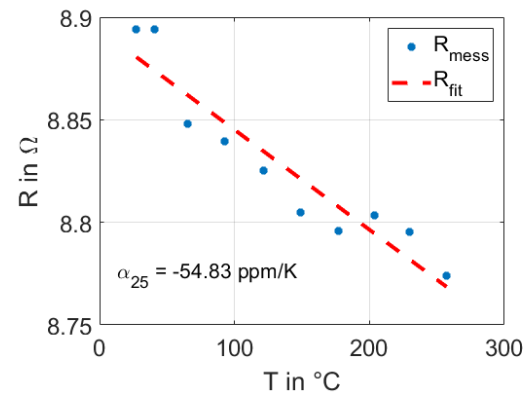
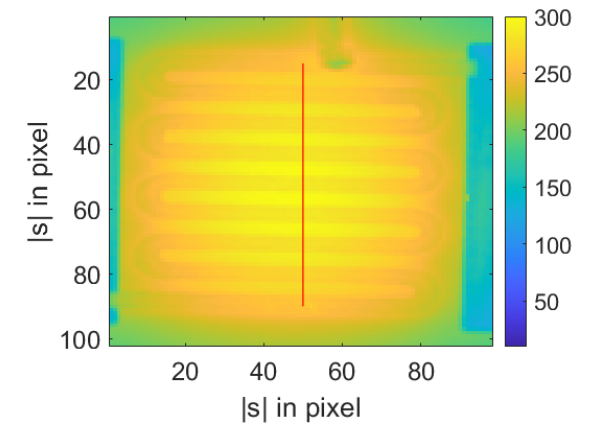
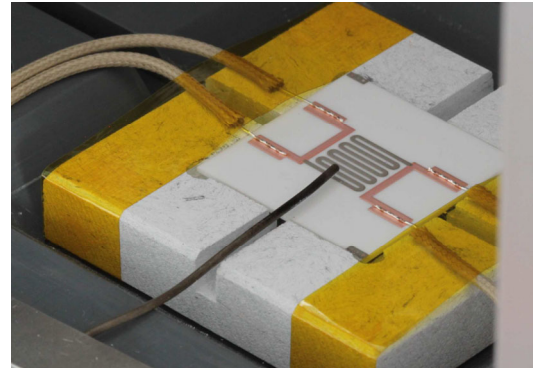
Base metal pastes

■ Testing as heater elements

- Power controlled: 1 ... 8 W
- Electric parameters are recorded with IR-data simultaneously

■ Results

- Temperatures up to 300 °C reached
- Homogenous temperature distribution
- TCR 25...250°C is -55 ppm/K



Current research topics

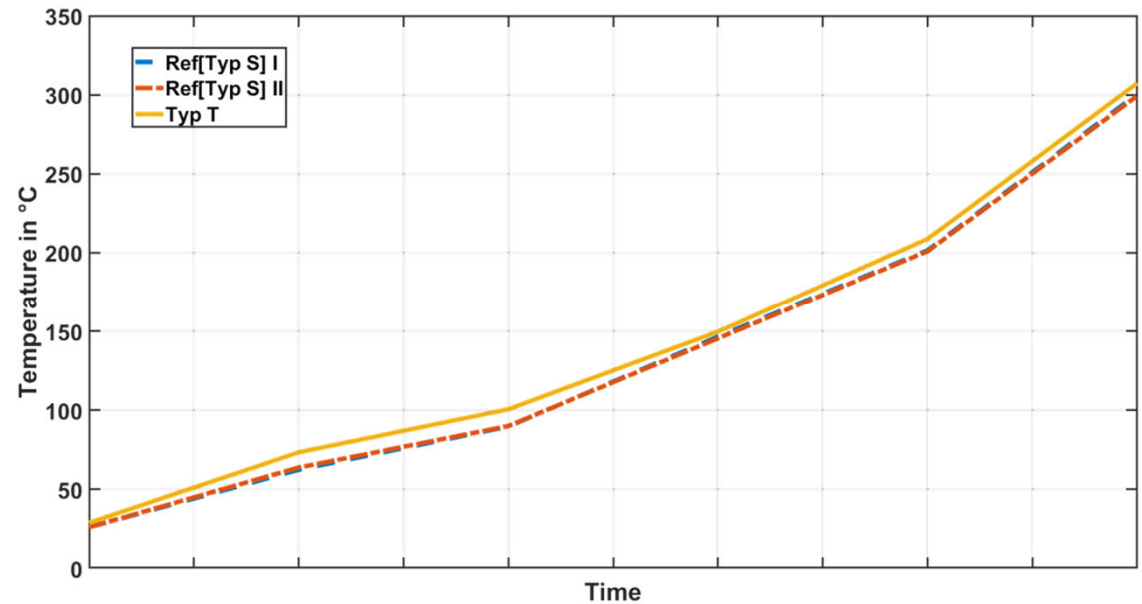
Base metal pastes

■ Testing as thermocouple

- Controlled temperature using a climate chamber
- Comparison to a standard Type S thermocouple

■ Results

- Temperature sensitivity is given
- Shape and progression of printed thermocouples are similar to conventional system



Main Research Topic **RF/ mmWave**

Photo-image able (PI) pastes

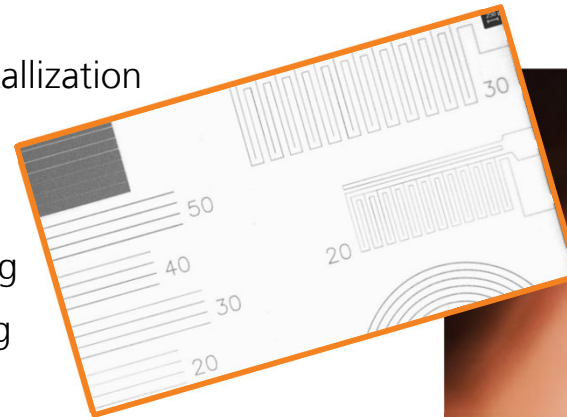
■ **Topic:** new lithography-based technology for fine-line metallization

■ **Objectives:**

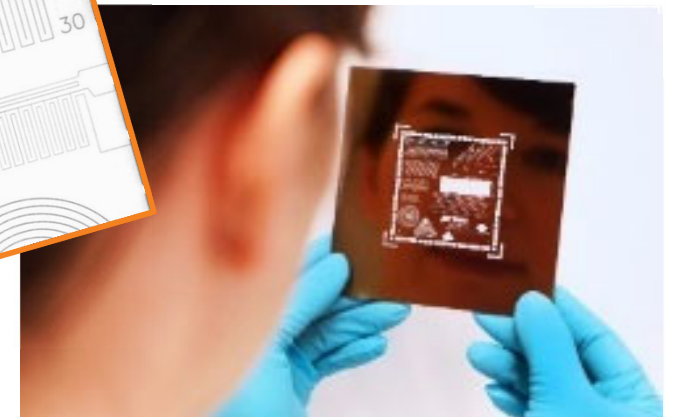
- **Improved printing resolution** ($<10\mu\text{m}$),
- **Improved surface quality, new features:** e.g. fencing

■ **Process:** Screen printing – exposure – development – firing

■ **Materials:** Ag, Au, Cu, glasses, **LTCC**



Klick for further [information](#)



LTCC-PI

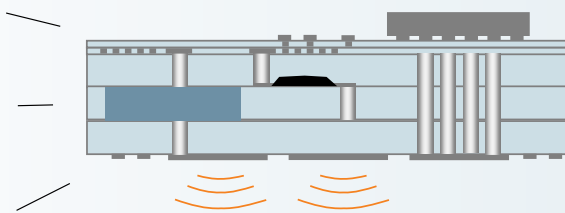
20 μm I/s, 30 μm vias

LTCC-Standard core

75 μm I/s, 75 μm vias

LTCC-PI

20 μm I/s, 30 μm vias



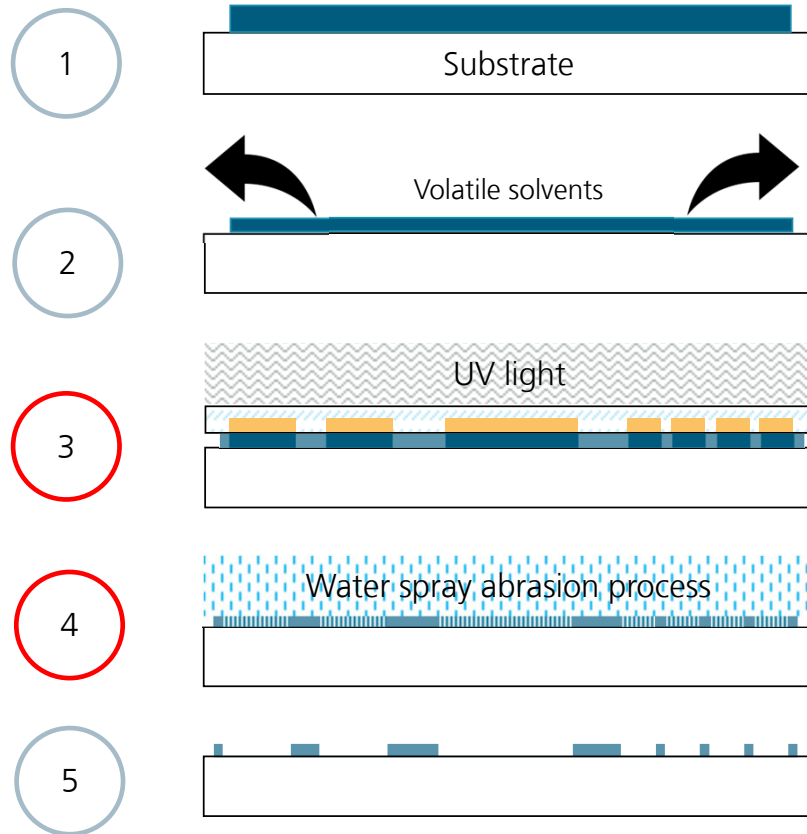
Embedded RLC
Embedded PI films
Thermal vias

Photo-imaging of thick-films

- Printing mask-based
- Exposure LDI, spray developing
- Max. resolution $<10\mu\text{m}$

PI process

The look inside



(1) Screen Printing

(2) Drying

(3) First Additional Step (4-15 sec.):

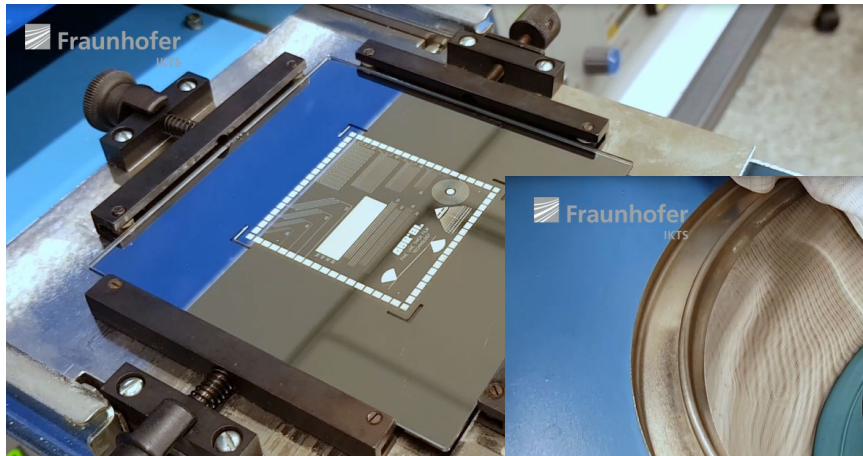
Exposure with UV light through a photo mask or LDI (Laser Direct Imaging)

(4) Second Additional Step (4-12 sec.):

Imaging via Developing Step (water based chemical solutions)

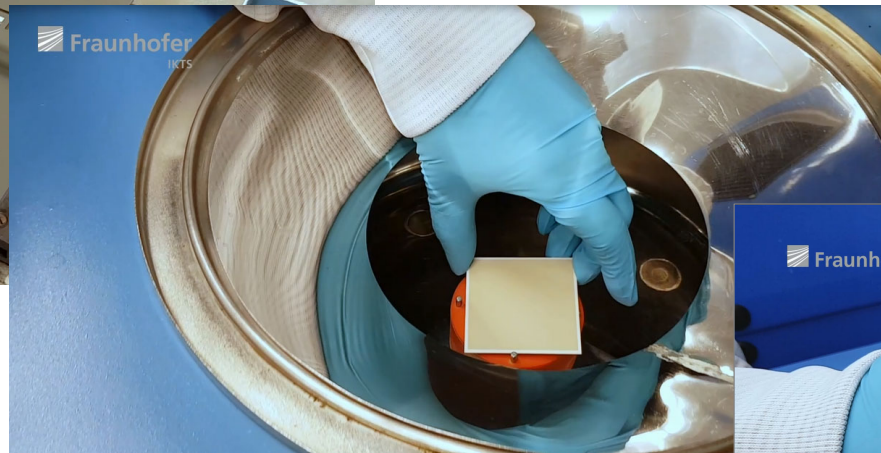
(5) Firing

PI process – The look inside

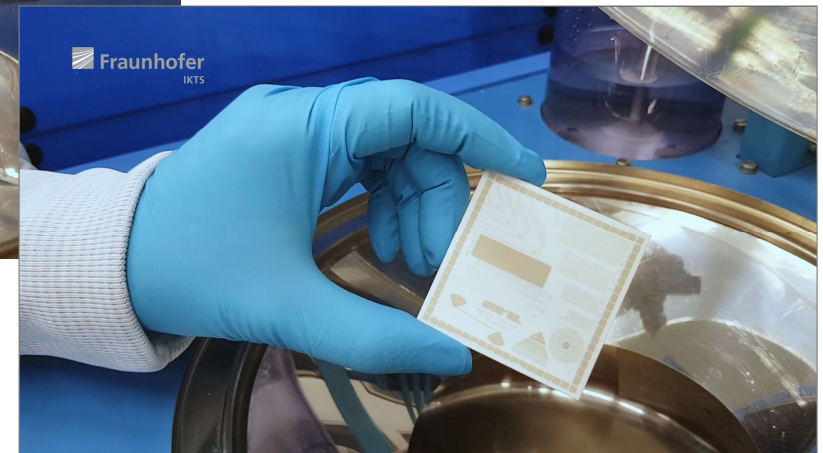


Exposure (4-15 s)

No Yellow room necessary!



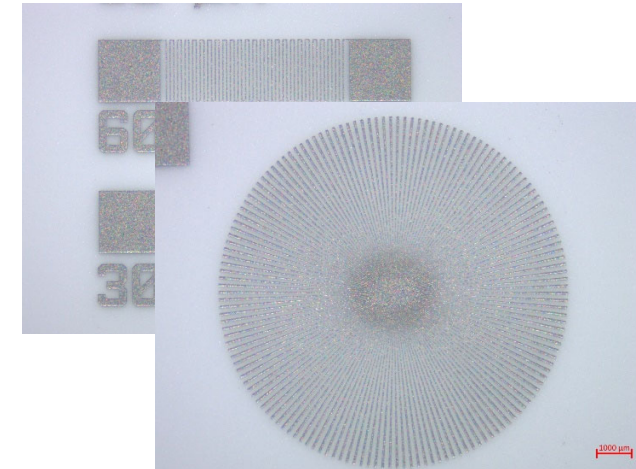
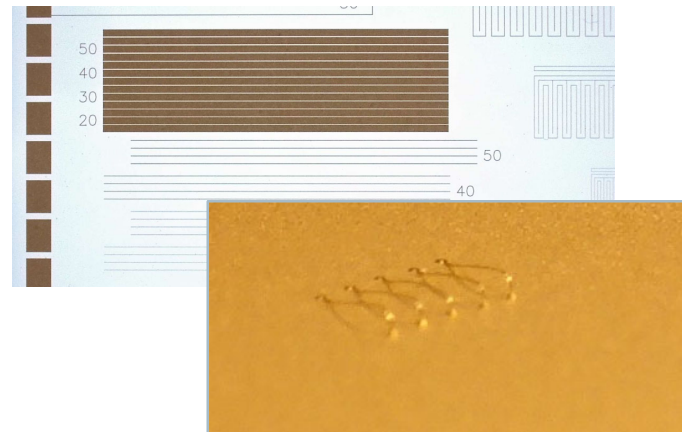
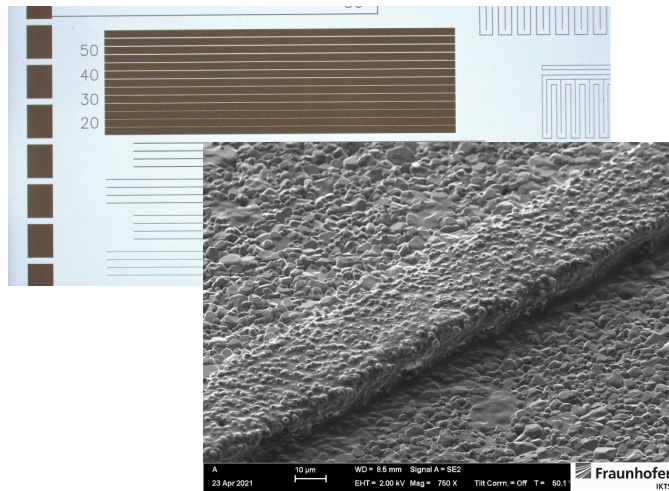
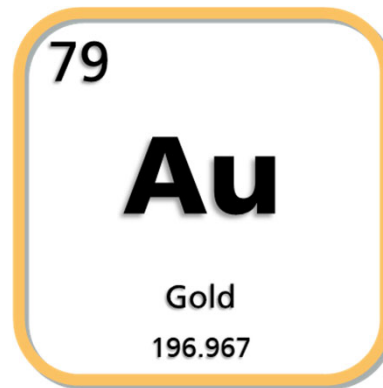
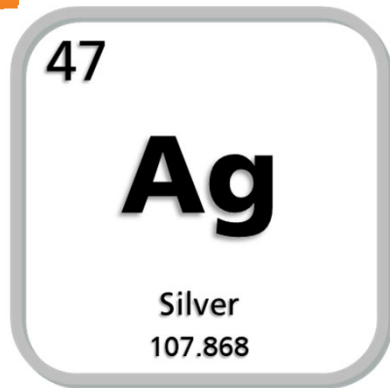
Developing (4-12 s)



Structured substrate

PI process

Paste development



Paste development for PI Al_2O_3

Characteristics	Unit	Value
Viscosity ¹	Pa·s	40...90
Sheet resistivity ^{2, 3}	mOhm/Sq	≤ 3.5
Fired film thickness ³	μm	8...12
Line Resolution		
Line/space	μm/μm	20/20
Solder acceptance ^{3, 4}	%	≥95
Adhesion ⁵	N/4 mm ²	≥20

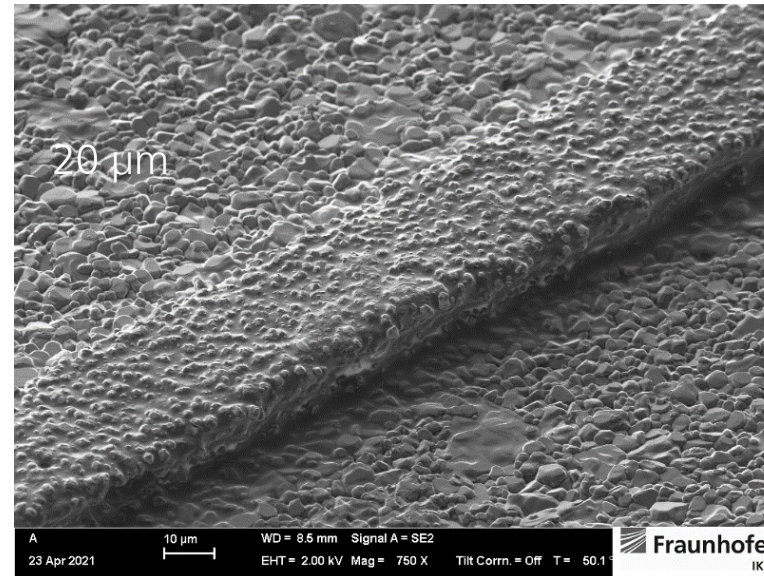
¹ Rotational viscometer ARG2 with cone/plate combination (2 cm, 2°) at 10 s⁻¹ and 22±0.2 °C.

² Sheet resistivity, calculated for a fired thickness of 10±1 μm.

³ Firing profile: total cycle time 60 min, 10 min at 850 °C.

⁴ Flux: Alpha 611, 220 °C, 5 s dip.

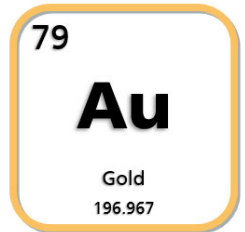
⁵ 90° wire-peel-test according to DIN 41850-2, 2 x 2 mm² pads, Sn/Pb/Ag 63/35,5/1,5 solder.



PI1101A – Ag Paste



Paste development for PI Al_2O_3

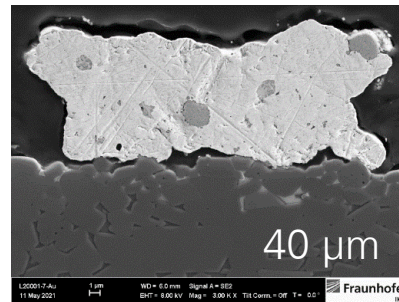
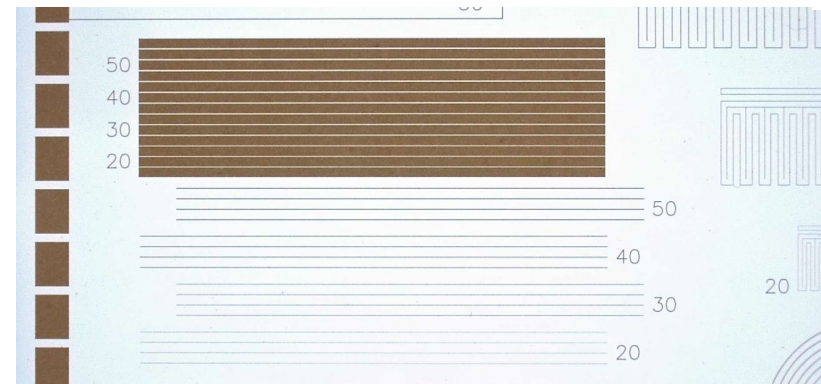


Characteristics	Unit	Value
Viscosity ¹	Pa·s	30...90
Sheet resistivity ^{2, 3}	mOhm/Sq	≤ 6
Fired film thickness ³	μm	8...15
Line Resolution		
Line/space	μm/μm	20/20

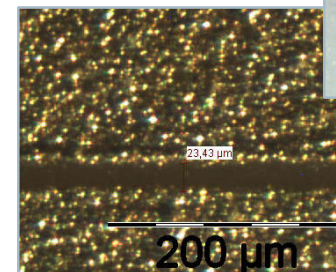
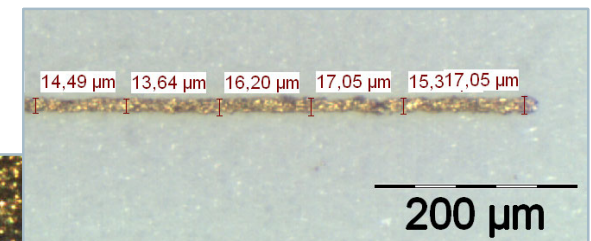
¹ Rotational viscometer ARG2 with cone/plate combination (2 cm, 2°) at 10 s⁻¹ and 22±0.2 °C.

² Sheet resistivity, calculated for a fired thickness of 10±1 μm.

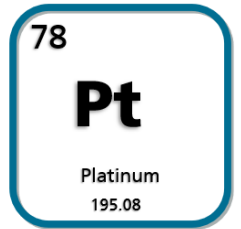
³ Firing profile: total cycle time 60 min, 10 min at 850 °C.



PI2101 – Au Paste



Paste development for PI Al_2O_3

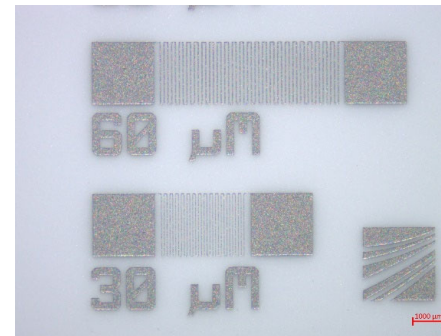


Characteristics	Unit	Value
Viscosity ¹	Pa·s	60...120
Sheet resistivity ^{2, 3}	mOhm/Sq	≤ 40
Fired film thickness ³	μm	6...12
Line Resolution	μm/μm	
Line/space		20/30

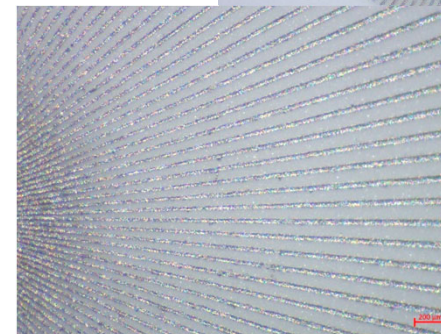
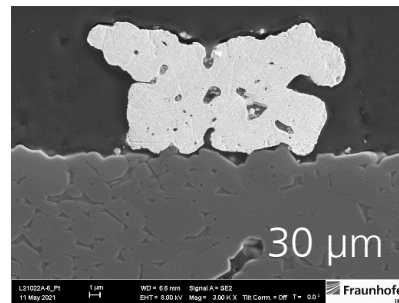
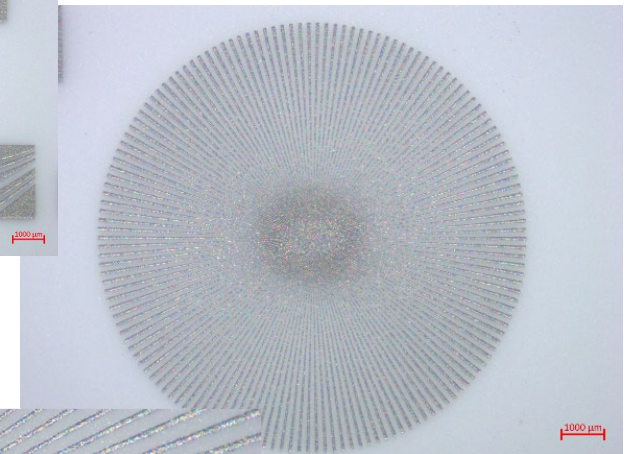
¹ Rotational viscometer ARG2 with cone/plate combination (2 cm, 2°) at 10 s⁻¹ and 22±0.2 °C.

² Sheet resistivity, calculated for a fired thickness of 10±1 μm.

³ Firing profile: 10 min at 1200 °C.



PI6101 – Pt Paste



Currently under development

Paste development for PI Al₂O₃

Characteristics	Unit	Value
Viscosity ¹	Pa·s	90...140
Sheet resistivity ^{2, 3}	Ohm/Sq	3.5k
Fired film thickness ³	µm	11...17
Line Resolution	µm/µm	
Line/space		40/35

¹ Rotational viscometer ARG2 with cone/plate combination (2 cm, 2°) at 10 s⁻¹ and 22±0.2 °C.

² Sheet resistivity, calculated for a fired thickness of 10±1 µm.

³ Firing profile: 10 min at 850 °C.



W20024 – RuO Paste

Contact

Claudia Feller

Scientist:

Thick-film pastes, functional printing

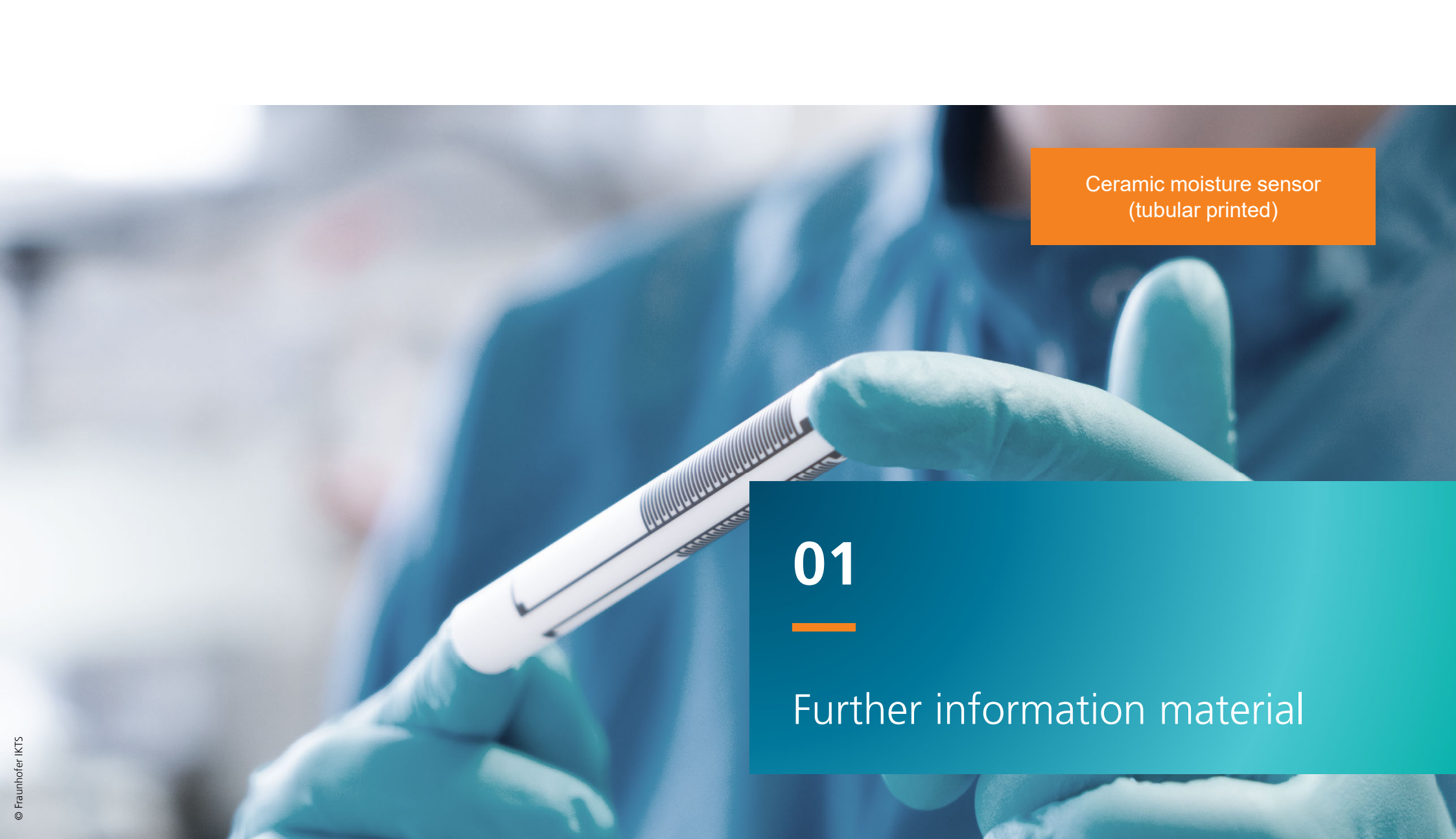
Phone +49 351 2553-7788

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Thank you for your attention!



Ceramic moisture sensor
(tubular printed)

01

Further information material

Department "Hybrid Microsystems"

Further research group information



Dr. rer. nat. Arno L. Görne

[Functional Materials for Hybrid Microsystems](#)

- Synthesis of functional ceramic materials (LTCC, ULTCC; magneto-ceramics, ferroelectrics, non-linear resistors (PTC, NTC), luminescent materials)
- Powder processing (high energy milling, spray tower, freeze drying)



Dr.-Ing. Stefan Körner

[Thick-Film Technology and Functional Printing](#)

- Functional pastes and inks, customized (conductors, TFR's, glasses, heaters, sensors, LTCC ...) adapted to different ceramics, LTCC, steel, different alloys, low T ... high T firing, photo image-able; printing technologies
- Advanced rheometry of printable suspensions



Dipl.-Chem. Beate Capraro

[Ceramic Tapes](#)

- Functional tapes (HTCC, LTCC, ULTCC, metal, piezo, magnetic, glass, Li-battery electrodes, transparent)
- Application adapted solvent/ binder/ plasticizer systems
- 7 casting machines, doctor blade (DB), DB on roll, slot-die and triple slot-die casting



Dr.-Ing. Steffen Ziesche

[Microsystems, LTCC and HTCC](#)

- LTCC and HTCC based components and systems (ceramic PCB, sensors, mixing and micro-reactor devices, packages, actuators)
- Technology and process development
- Component and multilayer circuit design/ layout



Dr.-Ing. Lars Rebenklau

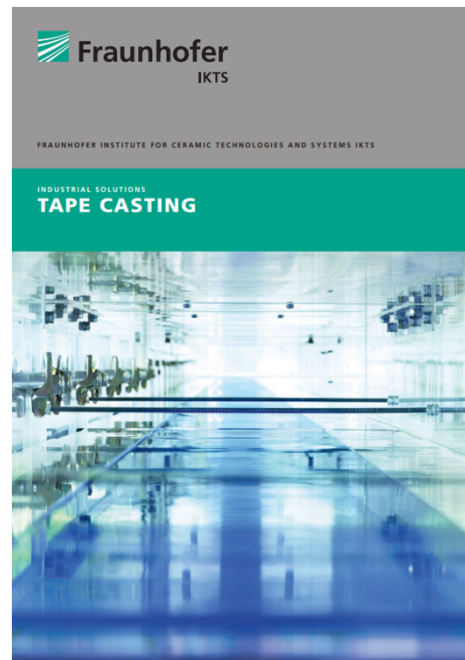
[Systems Integration and Electronic Packaging](#)

- Packaging technologies – wire bonding (thin, heavy, ribbon), welding, reflow/ selective soldering, Ag nano sintering
- Functional characterization and reliability (pull/shear force, IR, power cycling, ESD, isolation resistance, STOL, R_{sq} /TCR, T shock, humidity, salt fog, mechanical shock)

Further information material



Catalogue



Brochure



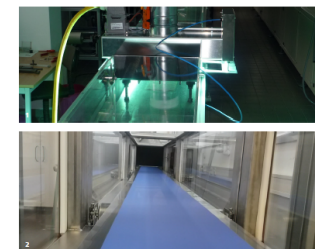
White Paper



LTCC TAPES ACCORDING TO HERAEUS FORMULA

The tape casting technique is predestined for the production of thin, planar ceramic tapes, which can be used individually or laminated as LTCC or HTCC multi-layer components. In future, tapes made of Low Temperature Co-fired Ceramics (LTCC) for the series Heratape®CT 700 and CT 800 of Heraeus Deutschland GmbH & Co. KG are cast for customer projects at the extended tape casting pilot plant at Fraunhofer IKTS in Hermsdorf. As a result, these tapes are available again in the usual quality for users.

Fraunhofer IKTS has long-standing experience in casting and functionalizing ceramic and glass-ceramic tapes of various compositions and thicknesses. In its highly modern tape casting facility at the institute's site in Hermsdorf, ceramic tapes are manufactured according to customer requirements for a variety of applications. Considerable equipment for the preparation of ceramic slurries and the casting of tapes by the doctor blade method on stone or on roll is available. Furthermore, tapes for laboratory and pilot-plant scale can be realized by single- and triple-slot dies in batch and continuous processes.



1: Continuous casting plant with integrated UV modules at the tape casting facility of Fraunhofer IKTS in Hermsdorf.
2: Casting of a LTCC slurry according to the Heraeus Deutschland GmbH & Co. KG formula.

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Information sheet

Further information material



FRAUNHOFER INSTITUTE FOR CERAMIC TECHNOLOGIES AND SYSTEMS IKTS

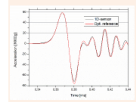


1. LTCC package of high-g 3D accelerometer fully assembled without lid (MEMS: Fraunhofer EMJ)
2. Wafer level manufacturing of LTCC sensor module with mounted MEMS
3. CT picture of 3D LTCC package with visible through-connections
4. LTCC wafer level manufacturing of 3D MEMS sensor

3D LTCC MEMS PACKAGE

Robust, hermetically sealed, SMD-compatible MEMS package
Micro-electromechanical systems (so-called MEMS) need a platform in the shape of a housing which has to comply, depending on the type of the MEMS, with different requirements.

Acceleration measurement 3D LTCC package up to 100 000 g (courtesy: Fraunhofer EMJ)



In the special case of a high-g 3-axis accelerometer a housing is required, which realizes the rewiring and the free moving space of the sensory element in three directions. These demands are enabled by the 3D

structuring of the LTCC multilayer ceramic that allows the acceleration measurement also in z-direction. Beside this requirement the LTCC package should withstand accelerations of up to 100 000 g. The developed ceramic package fulfills both demands exceedingly. A hermetically sealed encapsulation was realized for this kind of package, too. Further advantages are the optional adapted coefficient of thermal expansion to silicon and the possibility of miniaturization of the ceramic multilayer material. With the help of this technology the parallel manufacturing on wafer-level comparable to semiconductor manufacturing is possible.

Services offered

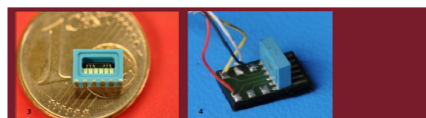
- Development of packaging solutions for CMOS, MEMS, MEMS components
- Setup and testing of pilot series
- Reliability testing of sensors

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322-W-15-2-25



FRAUNHOFER INSTITUTE FOR CERAMIC TECHNOLOGIES AND SYSTEMS IKTS



1. Wafer based fabrication of LTCC MEMS packages
2. Accelerometer contacted by aerosol printing
3. Side comparison of an LTCC MEMS package
4. SMD soldered LTCC MEMS package on PWB substrate

LTCC MEMS PACKAGING

Developing robust, hermetically sealed, SMD-compatible MEMS packages

In the field of sensors and actuators there are special applications that demand extreme requirements for both the sensor and its package. Especially in the industrial and automotive electronics as well as in the area of climate and environmental technology, there are high expectations on the reliability and robustness of the assembly and packaging technologies. All these requirements are fulfilled by the LTCC technology, which allows both the electrical rewiring inside the ceramic and the hermetic encapsulation. Other advantages of the LTCC material are the silicon-adapted coefficient of thermal expansion, the robustness of the ceramic solution and the possibility of miniaturization. Furthermore, it is a mass production technology similar to the wafer based semiconductor technologies (Figure 1). For the use in high-frequency applications or for special MEMS geometries the novel aerosol printing technology can be used (Figure 2). With this special 3D bonding method electrical connections to silicon chips or other active components over steps and edges of up to 4 mm can be realized. With line widths of 10 microns up to several millimeters and fills of various metallization types the technology can be used in different fields of application.

Services offered

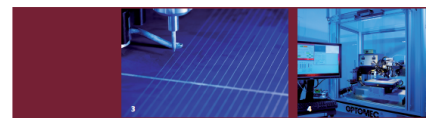
- Development and construction of individual LTCC MEMS packages
- Construction and testing of pre-series (LTCC fabrication, gluing equipment, wire bonding and glass bonding, aerosol printing technology)
- Hermetic encapsulation (glass bonding and gluing)
- Durability verification of the package (thermal aging and thermal shock)

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1. Inkjet printing of a 4x4 bit on Si wafer
2. Inkjet printer DOD 300 Schmidt
3. Aerosol printing of the finger grid of a solar cell
4. Aerosol printer Optomec: MPD

LAYER DEPOSITION TECHNOLOGIES

The deposition of functional films is very important in many sectors of industry, such as microelectronics, microsystems technology and sensor technology.

Equipment

The department of Hybrid Microsystems can provide the entire technology line for the manufacturing and characterization of screen printing pastes.

Furthermore, complete technology lines for the manufacturing of micro-structured films are available, such as:

1. Aerosol printing and
2. Inkjet printing as digital printing technologies.

3. Screen printing (planar, tubular) and
4. Gravure printing as mask-based technologies

These processes are used for the manufacturing of films with thicknesses between 25 nm and 100 µm. Structure widths are between few micrometers and some millimeters.

Line resolution	Line thickness
1. < 10 µm, 5 mm	15 nm - 100 µm
2. 50 - 100 µm	< 0.5 µm
3. > 10 µm, area	1 - 100 µm
4. > 50 µm, area	Expanding on existing pad
Velocity (m/s)	
1. 7-3500 m/s	
2. 6-15 m/s	
3. > 10.000 m/s	
4. > 100.000 m/s	

Services offered

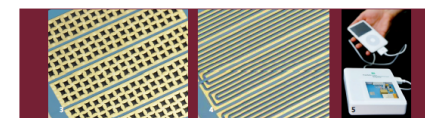
- Development and characterization of pastes
- Development and manufacturing of components for microelectronics, microsystems technology and sensor technology using several deposition technologies

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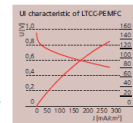
1. LTCC PEMFC charging unit with 3 W output power
2. LTCC PEMFCs in different performance classes
3. Cathode of a self-breathing PEMFC
4. Anodic flow field structured by laser
5. µPEMFC charging unit with 1 W output power

LTCC PEMFC

Motivation

Proton Exchange Membrane Fuel Cells (PEMFC) are well suited for self-sustaining energy supply units. Such systems have the following advantages in comparison with usual batteries or accumulators:

- High energy density (small, light-weight)
- Fast rechargeable
- No self-discharging



Low Temperature Cofired Ceramics (LTCC) is a technology for the manufacturing of highly integrated ceramic electronic packages. Furthermore, LTCC material properties are well adjusted to the usage in microsystem technology. In addition to the already electrical functions, 3D structures are integrated which can either be used for the transport of fluids or for realizing other mechanical functions. Regarding the necessary electrical power for high density energy sources in mobile electrical systems, the LTCC technology is suited in a special way to integrate miniaturized components.

Services offered

- Development of customer-specified PEMFC systems using LTCC as a system platform
- Integration of energy conversion, storage, DC/DC-conversion

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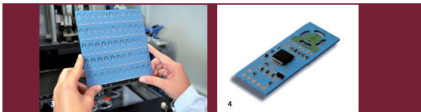
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Further information material



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1. Multiple printed panel pressure transducer.
2. Assembled pressure transducer.
3. Ball-inch LTCC substrate.
4. SMD assembled pressure transducer.

LTCC BASED PIEZO-RESISTIVE PRESSURE SENSORS

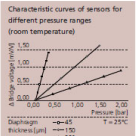
Motivation

LTCC (low temperature co-fired ceramic) is used for the implementation of highly integrated ceramic printed circuit boards. Additionally, three-dimensional structural elements (diaphragms, chambers, channels) can be implemented by the extended use of LTCC tape technology. Strain sensitive transducer layers can be inexpensively manufactured by screen printing technique.

They must be material and process compatible for the application in LTCC multilayer systems. Suitable layers for strain measurements are piezo-resistive thick films. The characteristics of thick-film resistors can change by different interactions with the LTCC substrate. Five different 10k Ω resistor patterns were characterized (log, TC, K-factor, N, MK, BD, TMA) and optimized regarding their compatibility to LTCC.

Results

The outcome of the tests was a paste with proper characteristics selected for the sensor application. Using finite element simulations the ideal positions on the membrane to place the resistors were found. Sensors for different pressure ranges were fabricated and characterized. With their good linearity, low hysteresis (stable) and long-term stability, these sensors increase the functionality of LTCC multilayers.

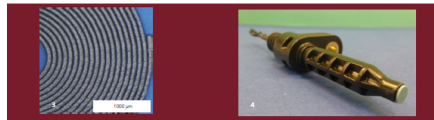


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1. Double-D LTCC miniature coil (8.4mm) for the integration into a turbocharger speed sensor component.
2. Detail of a polished cross-section through silver coil embedded in LTCC with high aspect ratio (x1000).
3. Printed spiral coil on LTCC with lateral winding distance of the printed coil of min. 25 μ m.
4. Turbocharger speed sensor with LTCC coil on the front (Source: Japnet Technology Group).

LTCC-BASED INDUCTORS FOR EDDY CURRENT SENSORS

Eddy current sensors are sensitive to electrical conductive materials and completely contactless. When this principle is implemented as sensors, they can detect path, distance, position as well as velocity. Measurements in highly contaminated environment or of covered objects are easily possible.

The multilayer ceramic technology offers an optimal platform for the flexible integration of eddy current measuring inductors with very small designs. LTCC multilayer printed and embedded inductors can be used in very rough environments and under operation temperatures up to 350 °C. The coil is typically located in the head of the sensor. A crucial element for its performance is the lateral winding distance of the printed coils can be reduced to 25 μ m. The metallization thickness can be simultaneously

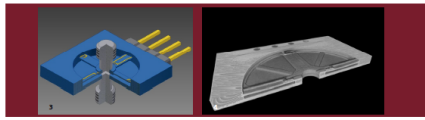
enhanced which reduces the internal resistance as well. Thus, the inductivity and the ohmic resistance achieve an obvious optimization that results in significant improvements of the inductors' quality factor compared to standard technologies. Embedded microconductors have a printed metallization aspect ratio of more than one and thus an optimal performance differing clearly from prior art. The developed LTCC-based inductors are inserted e.g. in turbocharger speed sensors for measuring of turbochargers speed for passenger cars and trucks. The measurement and control of turbochargers speed provides the key enabling technology for the optimal regulation of airflow into the engine and therefore to improve the fuel economy and reduction of engine emissions. Due to the compact construction of the inductors, the high quality factor and reliability as well as the innovative design the solution is optimally suited for speed sensor systems.

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1. LTCC-based miniaturized force sensors for three force ranges.
2. Fabrication in multiple panels: 25 sensors per 4 inch substrate.
3. Sensor module for 2 N in a sectional view.
4. CP picture of a 10 N load cell in a sectional view.

LOW-COST LTCC-BASED MINIATURIZED LOAD CELLS

Motivation

The multilayer technology LTCC (low temperature co-fired ceramic) is used for highly integrated ceramic printed circuit boards. The property to integrate three-dimensional structures, its linear material behavior and the fabrication in multiple panels allows for a cost-effective manufacturing combined with high sensitivity and linearity.

Results

The fabricated sensor modules work according to the piezo-resistive measuring principle. Deformable cantilevers combined to a cantilever structure are screen-printed with strain sensitive transducer layers. Different force ranges F_N (2 N, 5 N and 10 N) were designed and fabricated with almost the same layout. The following capable characteristics were measured:

Characteristics	2 N	5 N	10 N
Nominal load F_N			
Overload in % F_N	150	200	200
Sensitivity S (in mV/V)	2.6	0.6	0.1
Linearity	< 0.6	< 0.4	< 1.0
L in %FS			
TC-Sensitivity	0.02	0.03	0.02
in %/°K			
Material	< 5 μ mensor		
costs	(at 1000 pieces)		

Applications

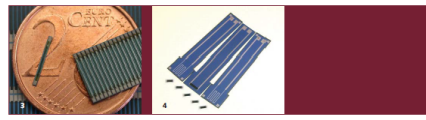
- Test and assembling equipment
- Microsystems
- Robotics
- Haptic systems

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1. CAD design of a temperature sensor in HTCC multilayer technology.
2. HTCC multilayer temperature sensor.
3. FTCC on LTCC.
4. FTCC on isolated steel and FTCC chip resistor.

T-SENSORS IN THICK-FILM AND MULTILAYER TECHNOLOGY

Motivation

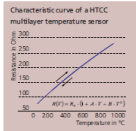
One main information concerning the actual state of numerous systems is their temperature. Often it is necessary to measure at different positions. Because of this reason compact and integrable solutions are essential. One possibility of temperature measurement are FTCC (positive temperature coefficient resistor).

Thick-film and multilayer technology are well suited for the manufacturing of these films with thicknesses between 2 and 100 μ m and lateral dimensions of some 170 μ m.

With the help of such technologies homogeneous, hermetic and very compact temperature measurement can be developed. The possible measurement range is up to 800°C.

Services offered

- Development of pastes with high temperature coefficients of resistance (TCR) for temperature measurements on customer-specific substrates
- Development and manufacturing of temperature sensors on different substrates (Al_2O_3 , AlN , Si_3N_4 , SiC) and in LTCC and HTCC multilayer technology
- Characterization and calibration of temperature sensors (0 = 20...1200°C)



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