Narodowe Centrum Badań i Rozwoju

Politechnika Wrocławska

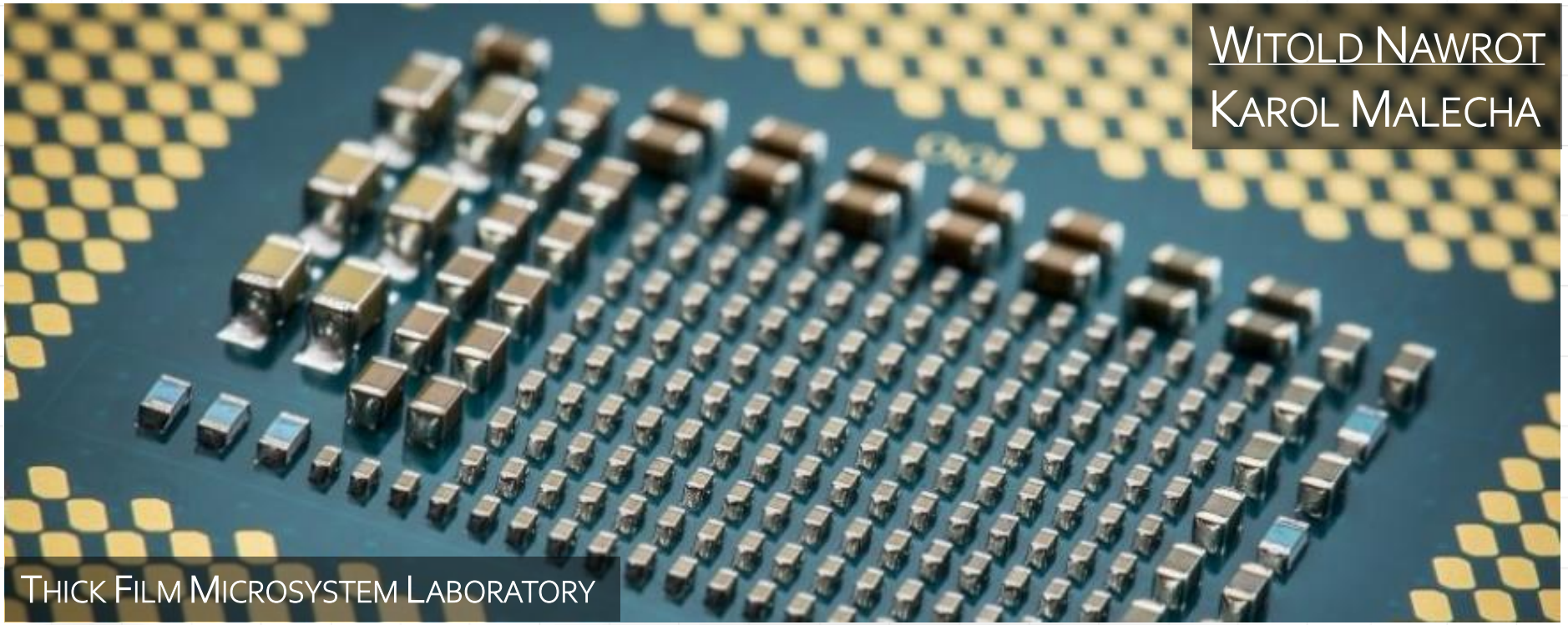
Progress on Spectroscopy and Imaging III, November 19th – 21st, 2019,
LOW TEMPERATURE COFIRED CERAMICS:
TECHNOLOGY AND APPLICATIONS

Witold Nawrot, Karol Malecha

Prezentacja promująca Projekt
Modularne Detektory GEM (MGEM)
Nr POIR.04.01.02-00-0080/17

Projekt współfinansowany przez Narodowe Centrum Badań i Rozwoju wybrany w ramach programu Program Operacyjny Inteligentny Rozwój
w Konkursie nr 1 - 4.1.2/2017_RANB.

Low Temperature Cofired Ceramics: Technology and Applications



Witold Nawrot
Karol Malecha

Thick Film Microsystem Laboratory

HR EXCELLENCE IN RESEARCH

Wrocław University of Science and Technology

BENEFITS OF CERAMIC MATERIALS

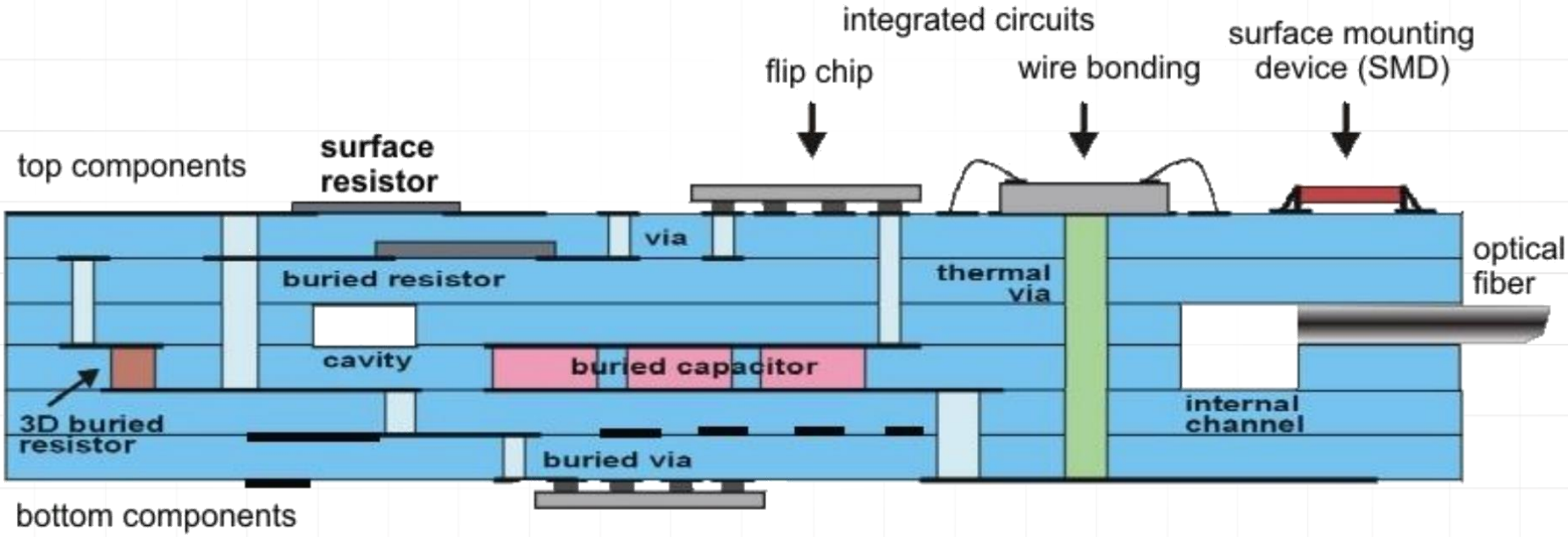
- High temperature stability
- High chemical resistance
- High insulation resistance and breakdown voltage
- Very hard
- Hermetic sealing capability
- Fine structuration
- Dense, multilayer interconnection capability
- Low dielectric losses
- Low thermal expansion

BENEFITS OF CERAMIC MATERIALS

	FR4	LTCC	Al_2O_3
Relative permitivity (1 MHz)	4.8	7.8	9.5
Loss tangent	2.2	0.0140	0.0001
Thermal expansion [ppm/K]	13 - 18	5.8	7.3
Thermal conductivity [W/(m·K)]	0,4	3	10 - 35

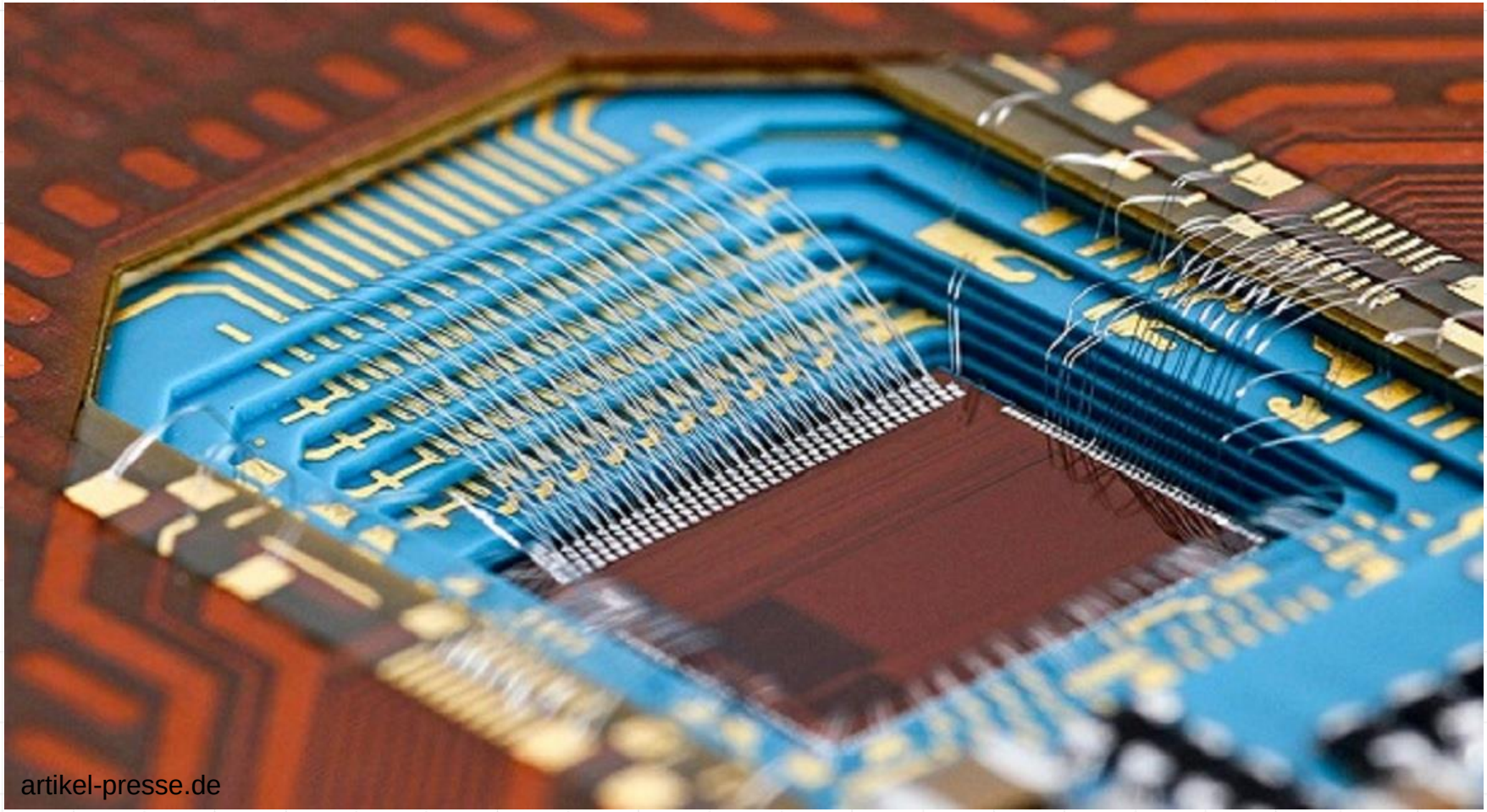
L. Golonka, K. Malecha, "Ceramic microsystems," Wrocław 2011;

LTCC CROSS SECTION

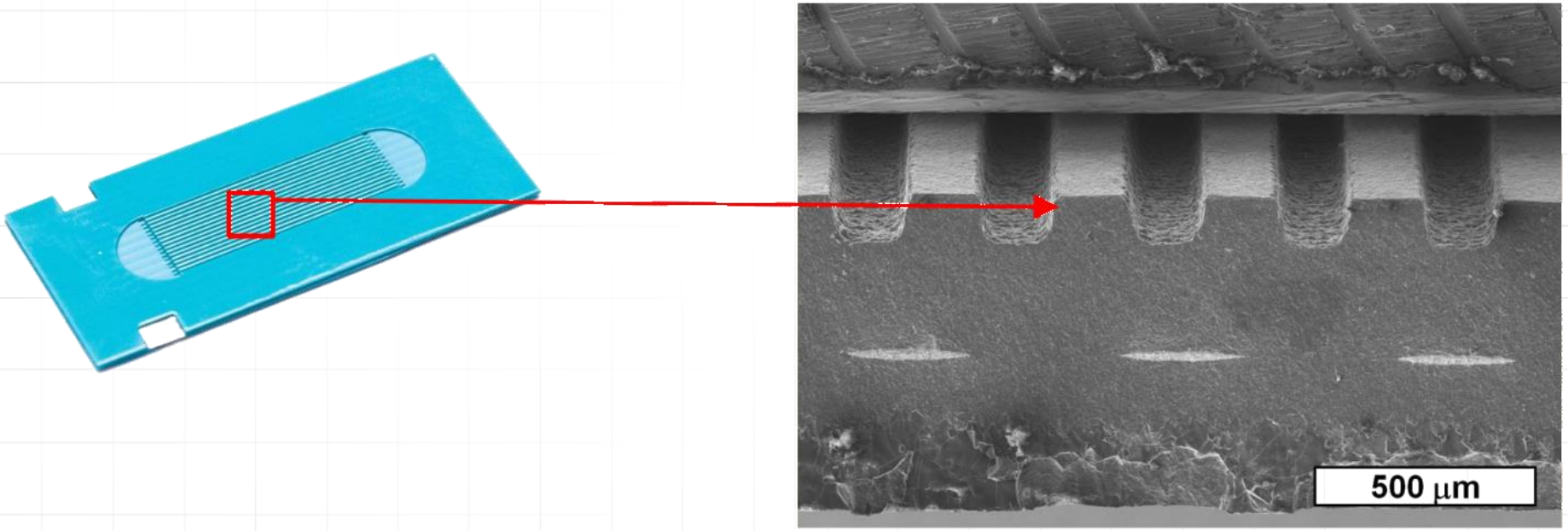


L. Golonka, K. Malecha, "Ceramic microsystems," Wrocław 2011;

DENSE MULTILAYER INTERCONNECTIONS

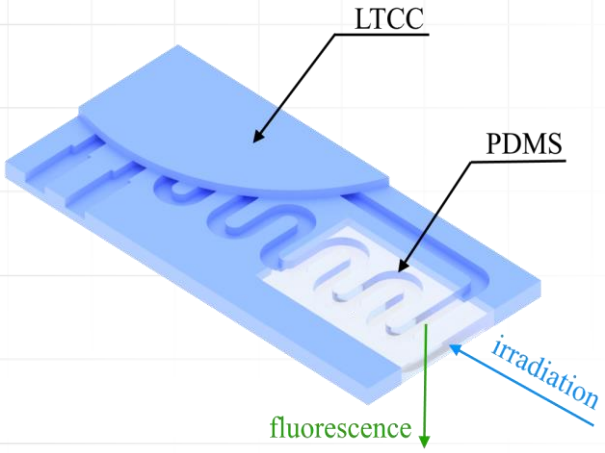


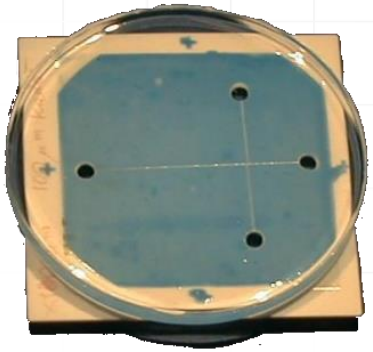
FINE STRUCTURATION

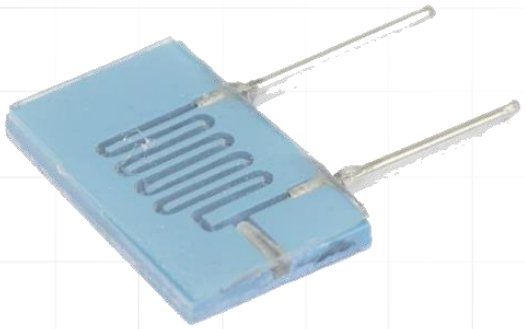


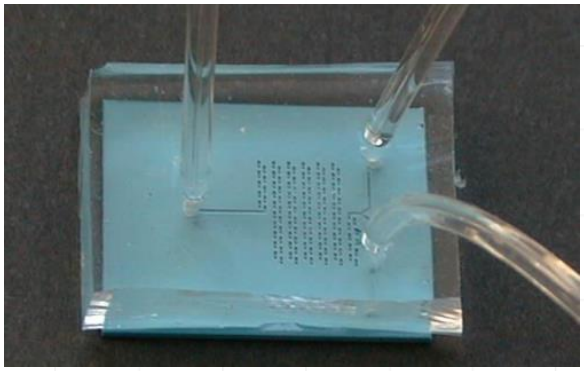
K. Malecha, E. Remiszewska, D. G. Pijanowska "Surface modification of low and high temperature co-fired ceramics for enzymatic microreactor fabrication," Sensors and Actuators B: Chemical 190 pp. 873-880 (2014)

BONDING WITH PDMS



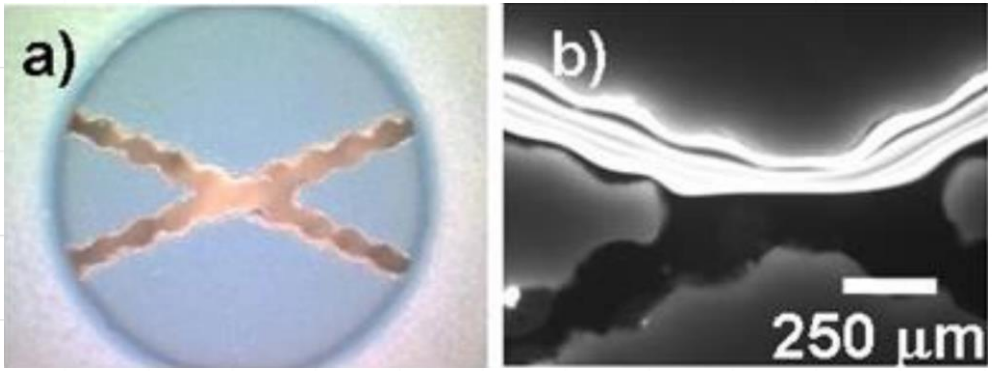






L. Golonka, K. Malecha, "Ceramic microsystems," Wrocław 2011;
W. Nawrot, K. Malecha, "Preliminary studies for hybrid LTCC-PDMS fluorescence sensor," 42nd International Microelectronics and Packaging IMAPS Poland 2018 Conference

BONDING WITH GLASS



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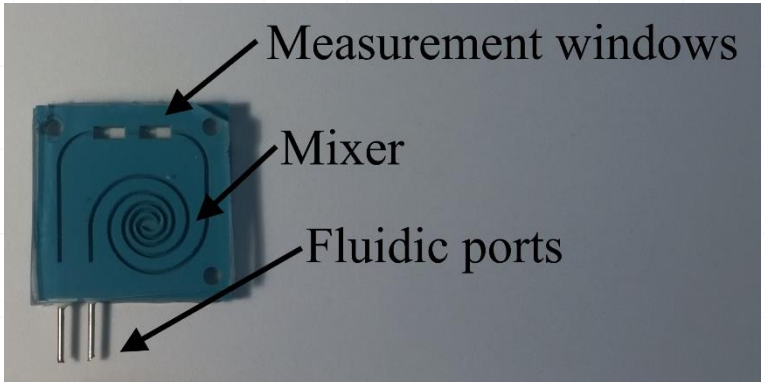
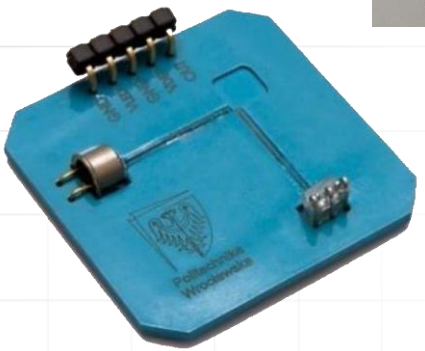
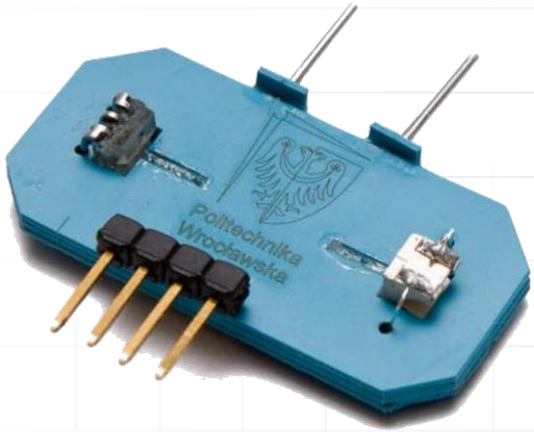
P. Bembnowicz, L. J. Golonka, "Integration of transparent glass window with LTCC technology for µTAS application," Jour. of the Eur. Cer. Soc., 30 (2010) 743-749.

OPTICAL SENSORS



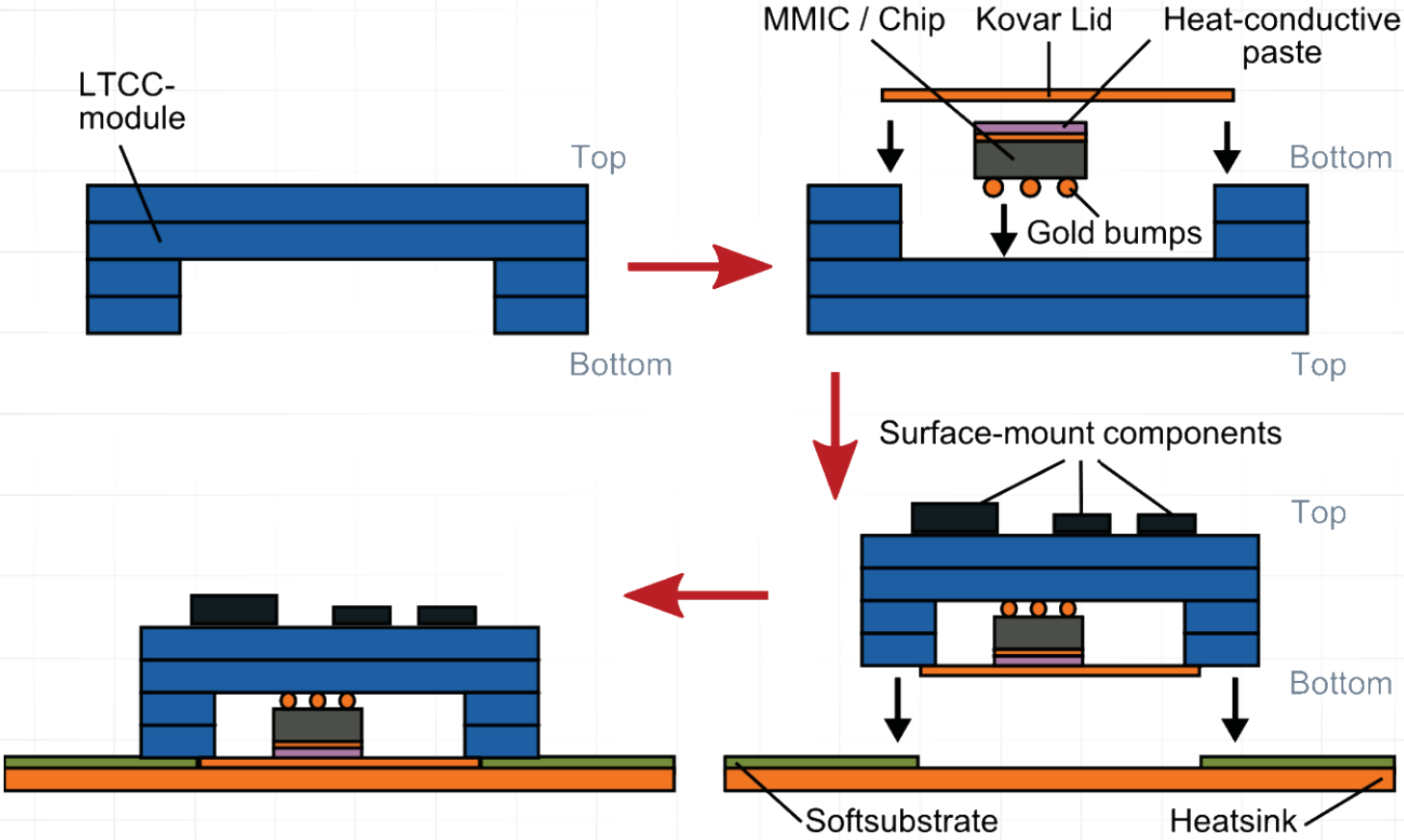




K. Malecha, M. Czok, A, Hetnar, A. Pawlik, H. Sztajer, L. J. Golonka "Micro Ceramic Cell Analyzer (MCCA) – Preliminary results, " Microelectronics Reliability 51 (7) pp. 1250-1252

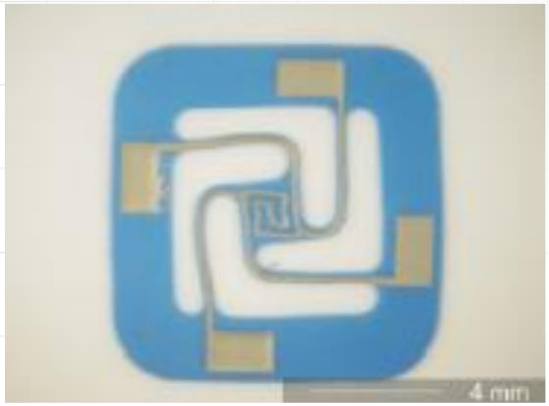
W. Nawrot, M. Fiedot-Toboła, K. Malecha "PDMS – LTCC Lab on Chip for photocatalytic effect analysis," 21st European Microelectronics and Packaging Conference (EMPC) & Exhibition, EMPC 2017

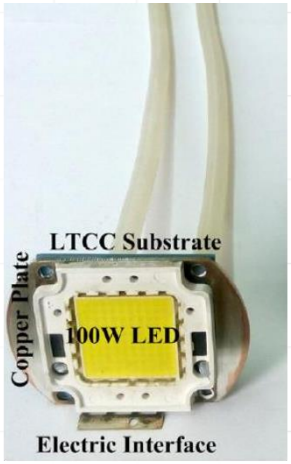
HERMETISATION

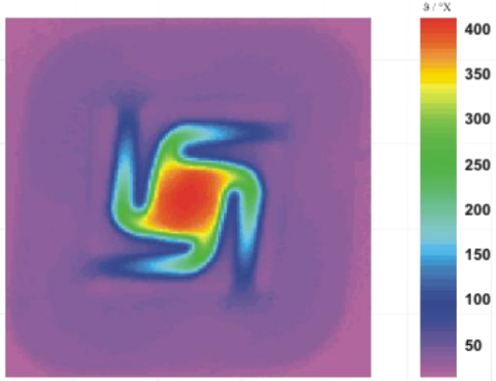


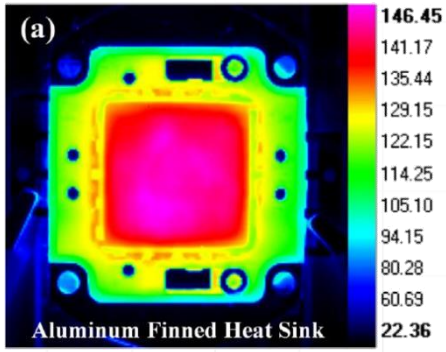
A. F. Jacob, "Packaging Approaches for Broadband Communication Systems," 11th European Microwave Integrated Circuits Conference 2016

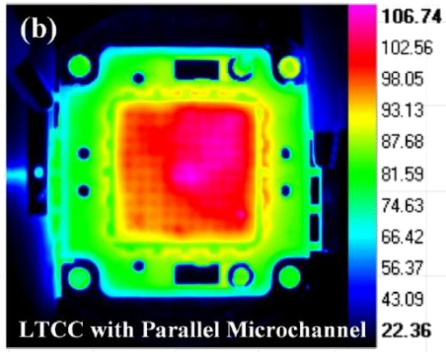
HEATING AND COOLING







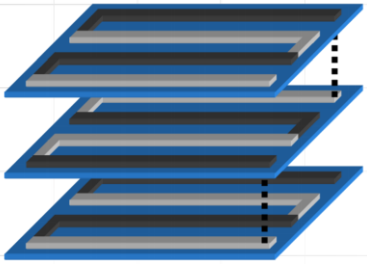


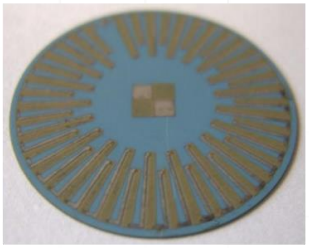


L.-Y. Zhang et al. / International Journal of Heat and Mass Transfer 84 (2015) 339–345

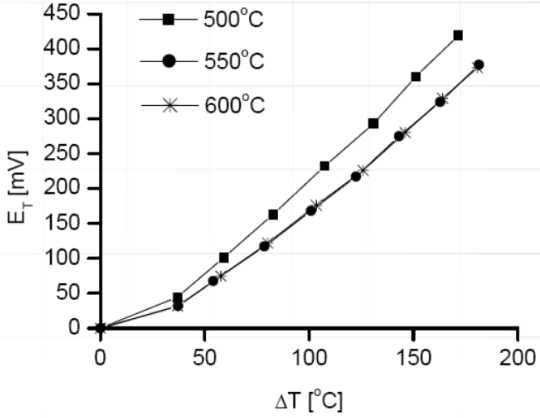
J. Kita, F. Rettig, R. Moos, K-H. Dr¨ue, and H. Thust, "Hot-plate gas sensors – are ceramics better?", Proc. 2005 IMAPS/AcerS 1st Int. Conf. and Exhib. on Ceramic Interconnect and Cer. Microsystem Technologies (CICMT), Baltimore (USA), 343–348 (2005).

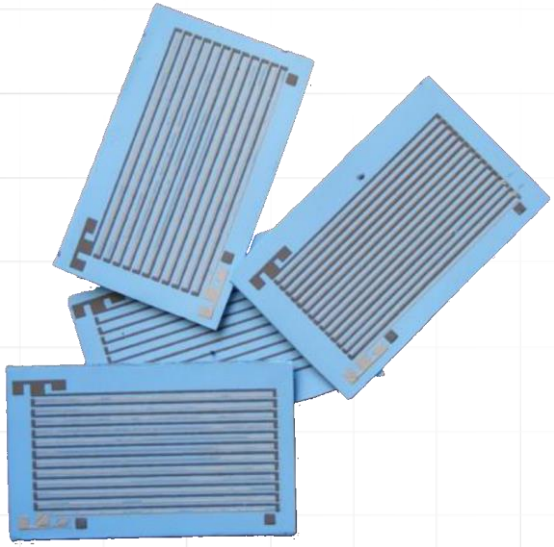
THERMOCOUPLES AND THERMOPILES

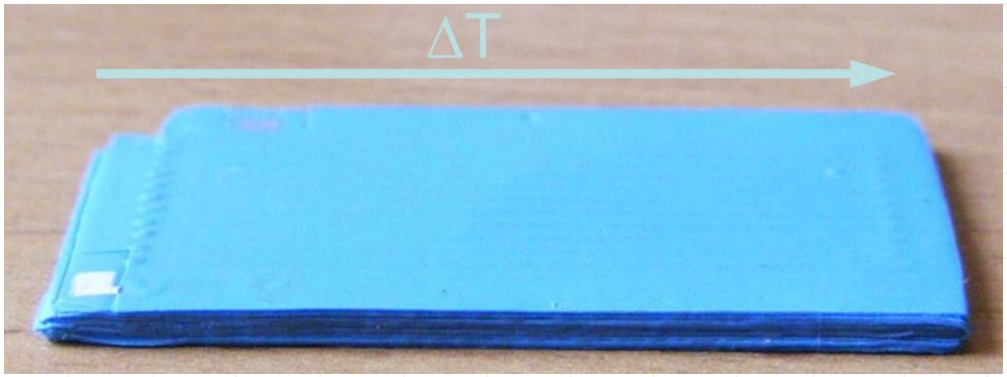




PdAg/TSG thermocouple

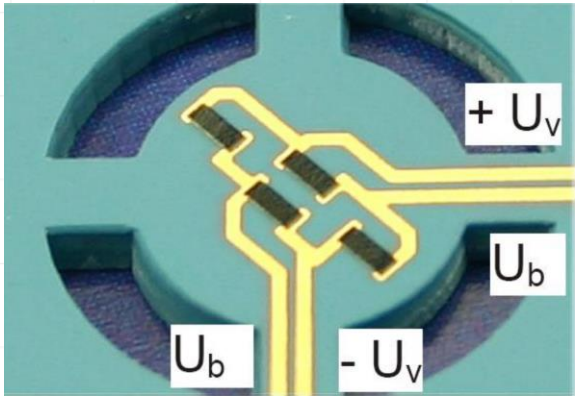


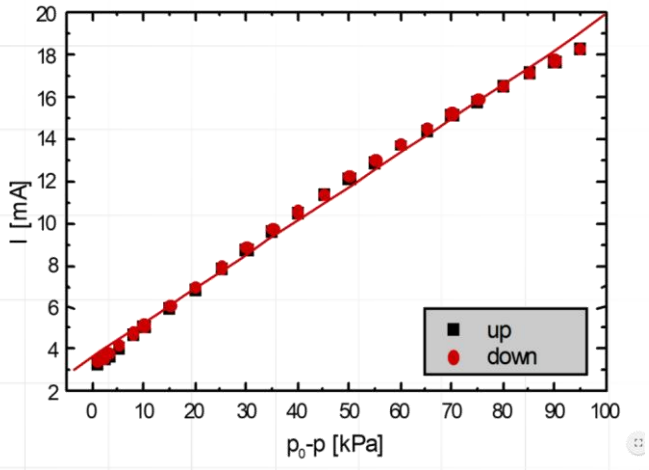




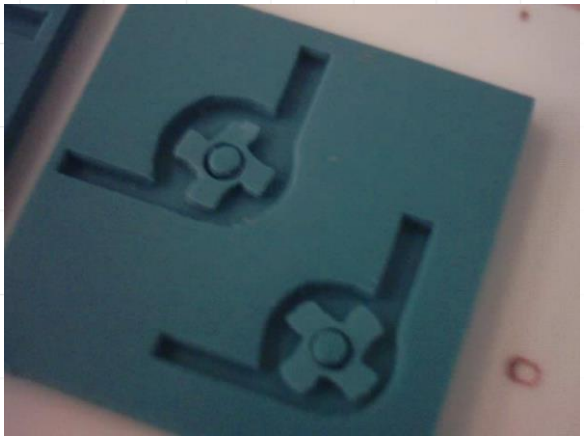
P. Markowski, A. Dziedzic"Planar and three-dimensional thick-film thermoelectric microgenerators," Microelectronics Reliability 48, (6)

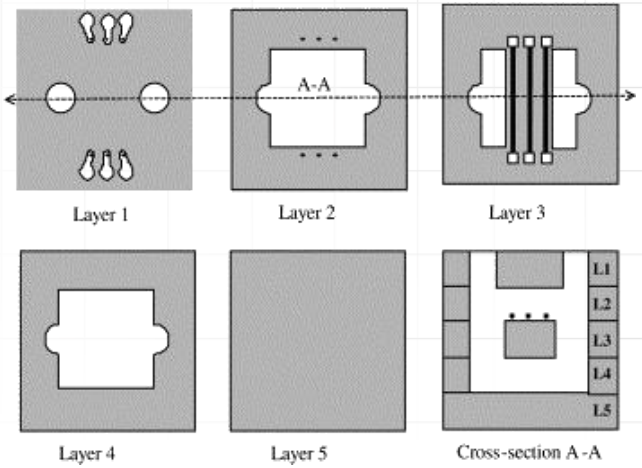
PRESSURE SENSORS

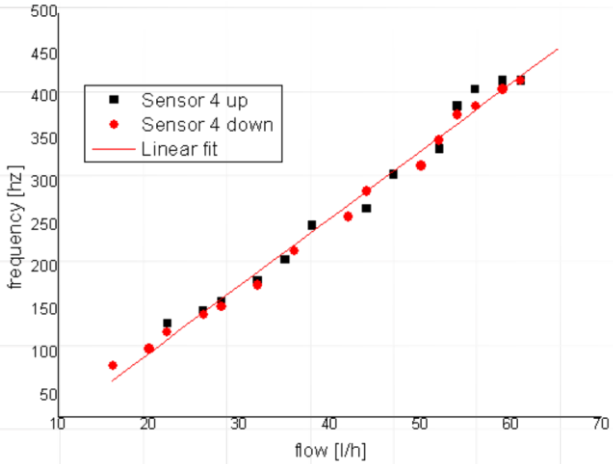


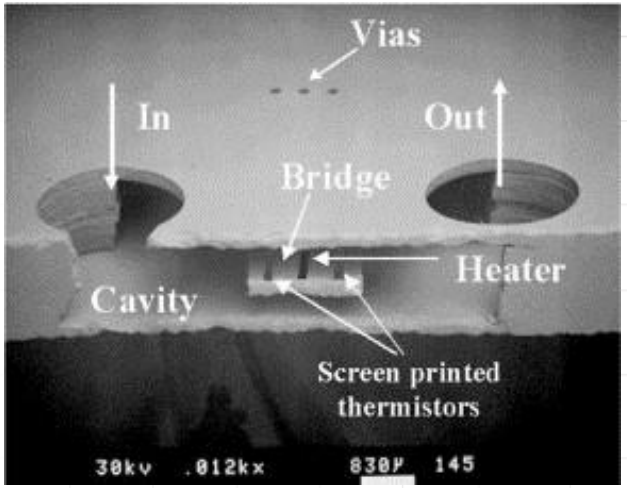


FLOW METRES









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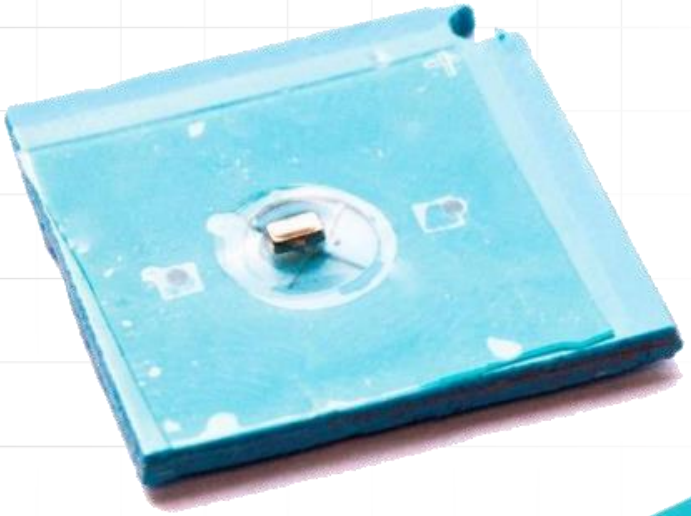
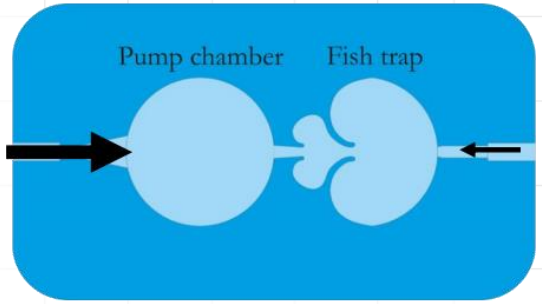
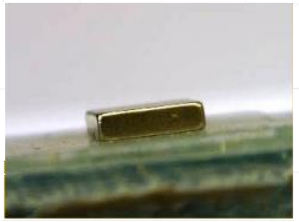
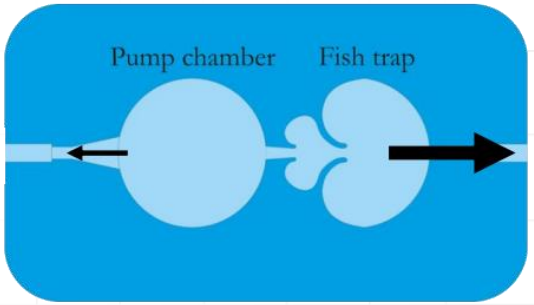
ACTUATORS





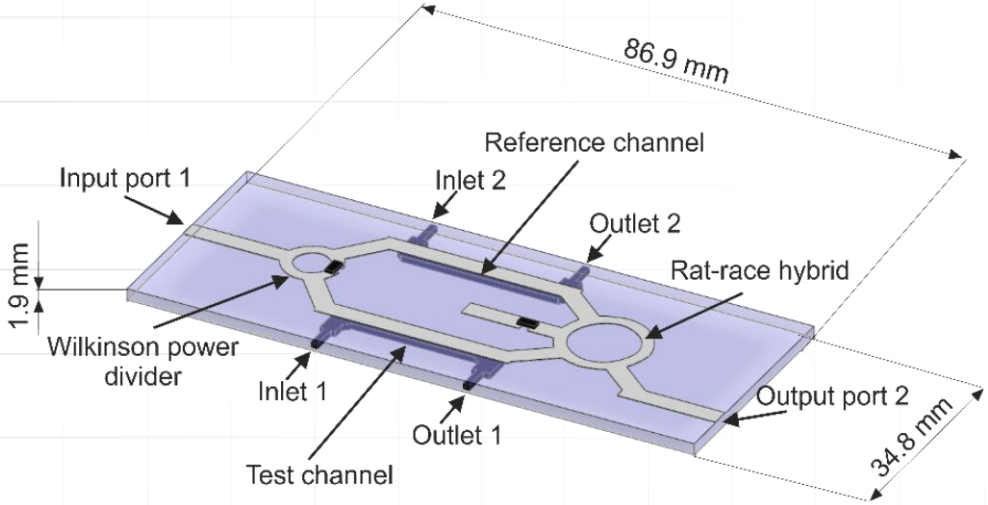




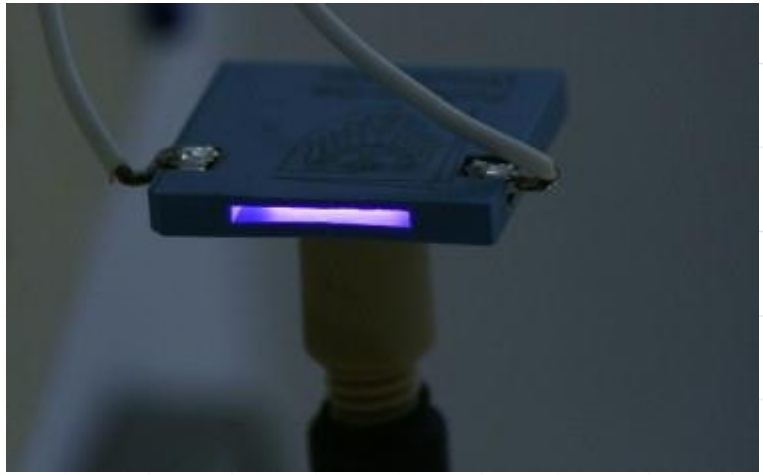
M. Czok, K. Malecha, L. Golonka "Electromagnetic valve made in low-temperature co-fired ceramics," International Journal of Applied Ceramic Technology. 2014, vol. 11, nr 3, s. 468-474.
M. Czok, K. Malecha, L. Golonka "Electromagnetic pump made in a hybrid polymer-ceramic technology - preliminary results," Journal of Chemistry and Chemical Engineering. 2014, vol. 8, nr 10, s. 985-989.

MICROREACTORS

MICROWAVE MICROFLUIDICS



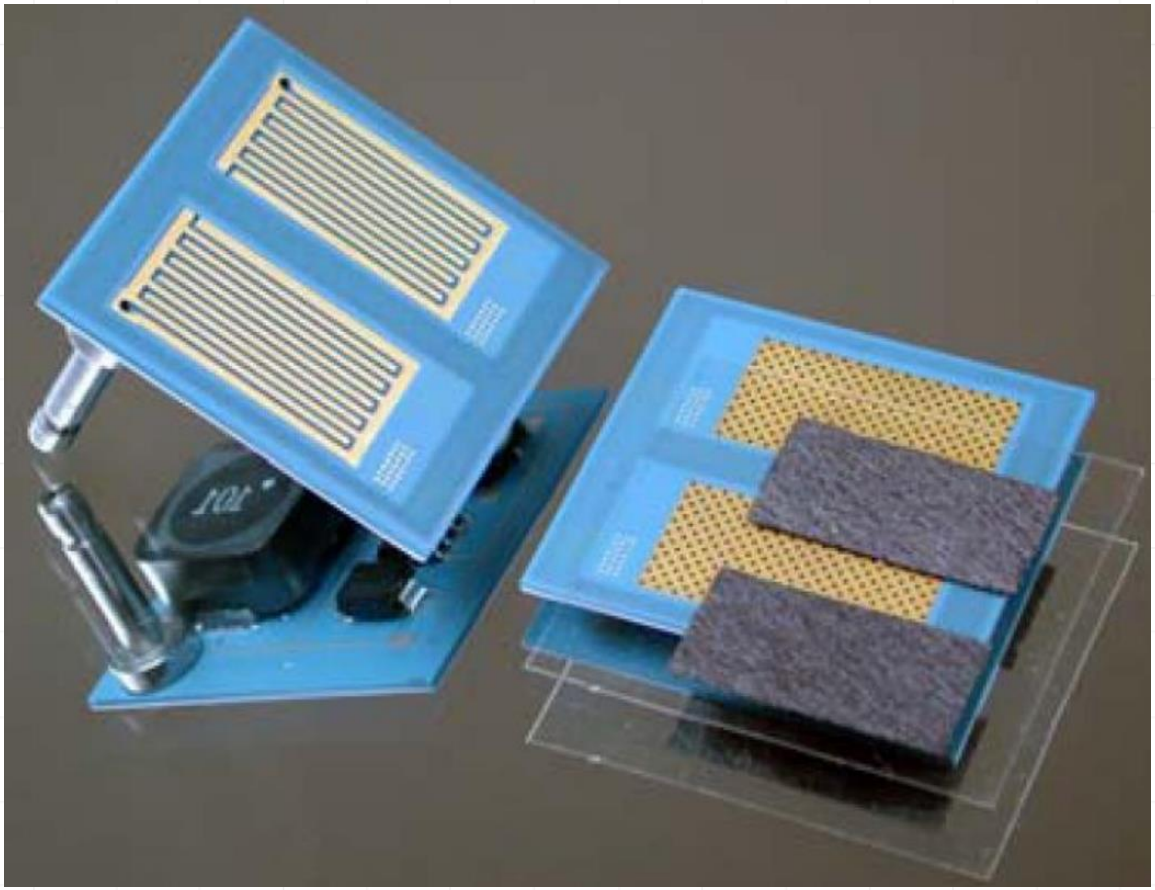
PLASMA MICROREACTORS



K. Malecha, L. Jasińska, A. Grytsko, K. Drzozga, P. Słobodzian, J. Cabaj "Monolithic Microwave-Microfluidic Sensors Made with Low Temperature Co-Fired Ceramic (LTCC) Technology", Sensors 19 (3) (2019)

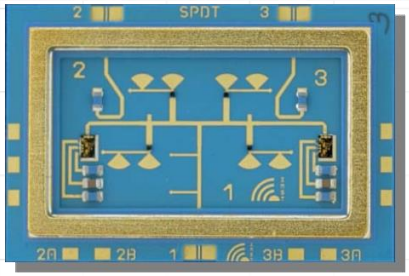
J. Macioszczyk, K. Malecha, H. Roguszczak, S. Patela, L.J. Golonka "Low Temperature Co-fired Ceramics Plasma Generator for Atmospheric Pressure Gas Spectroscopy", Sensors and Actuators A: Physical 223, pp. 174-179 (2015)

Fuel Cells

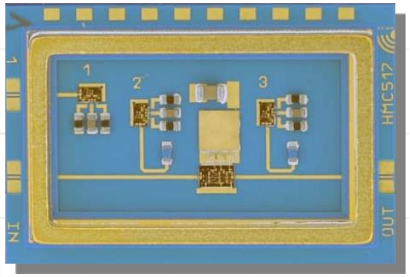


A. Michaelis "Application of ceramic technology for cost effective manufacturing of small fuel cell systems," International Conference and Exhibition on Ceramic Interconnect and Ceramic Microsystems Technologies (CICMT) 2007, Denver

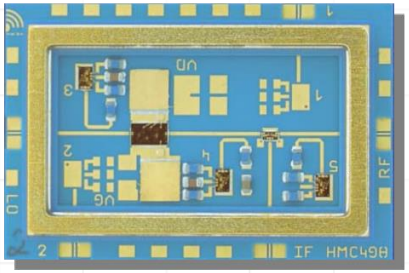
SPACE LTCC



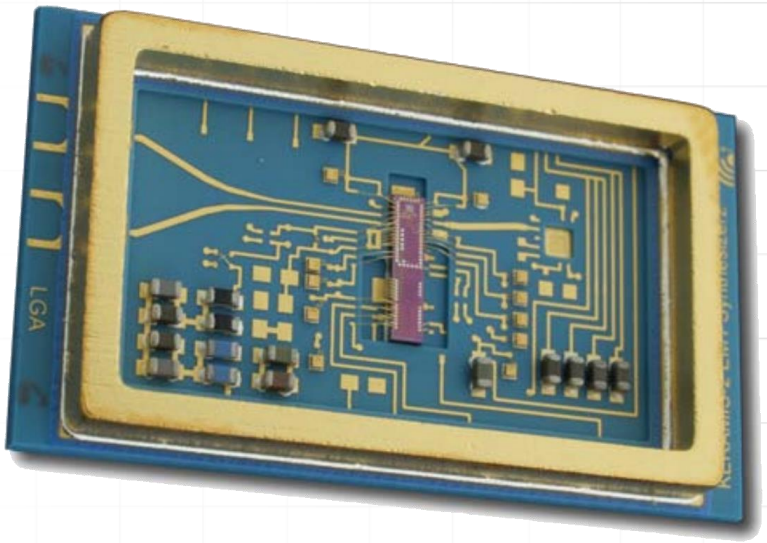
SPDT PIN Diodes Switch
with 2 Power Detectors



Low Noise Amplifier
with 3 Power Detectors



Medium Power Amplifier
Mixer and 3 Power Detectors

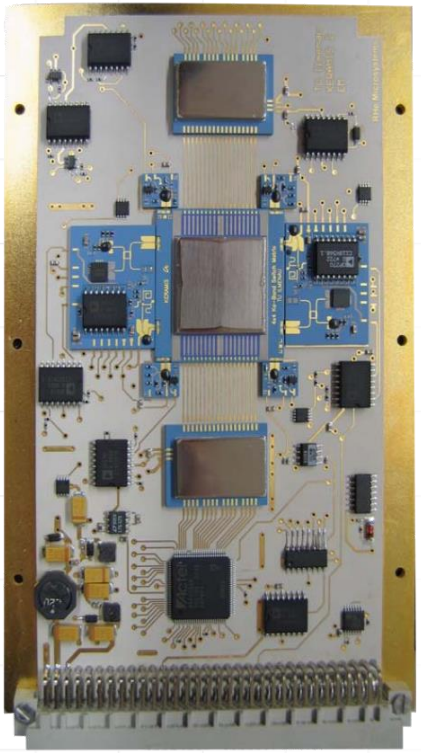


Synthesizer

I. Wolff, R. Kulke, T. Klein, "LTCC: A Space Qualified Integration and Packing Technology for Millimeter-Wave Systems,",IEEE International Microwave Symposium 2012, Montreal, Canada

SPACE LTCC

I

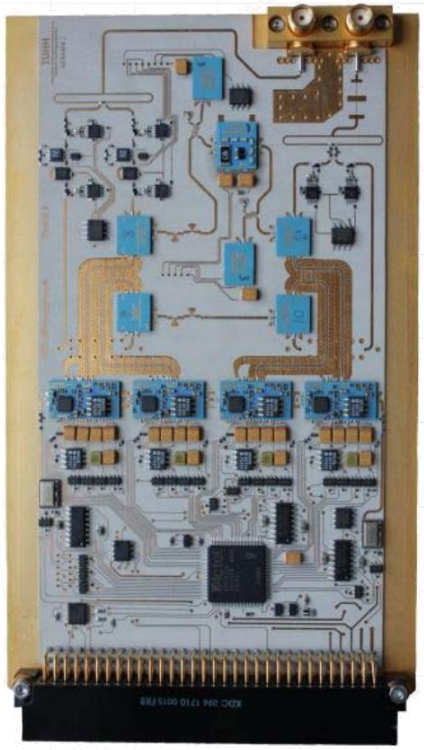


4x4 Switch matrix
TU-Ilmenau

II

Synthesizer
IMST

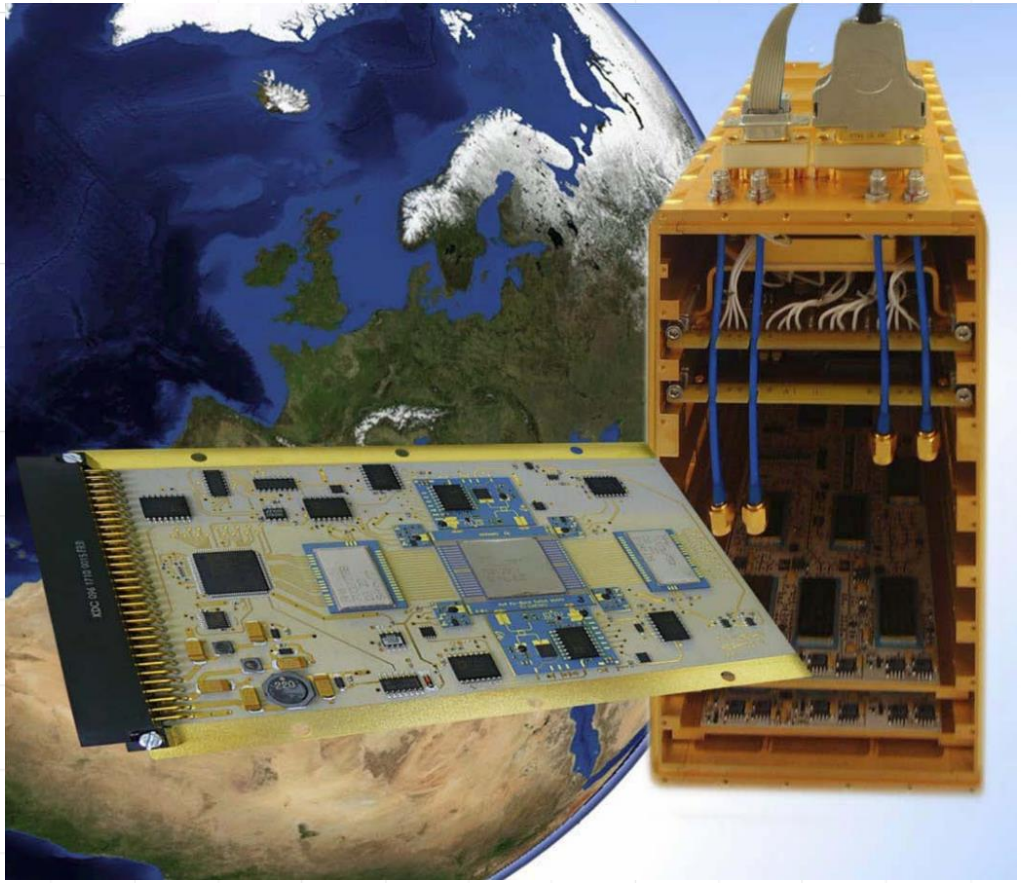
III

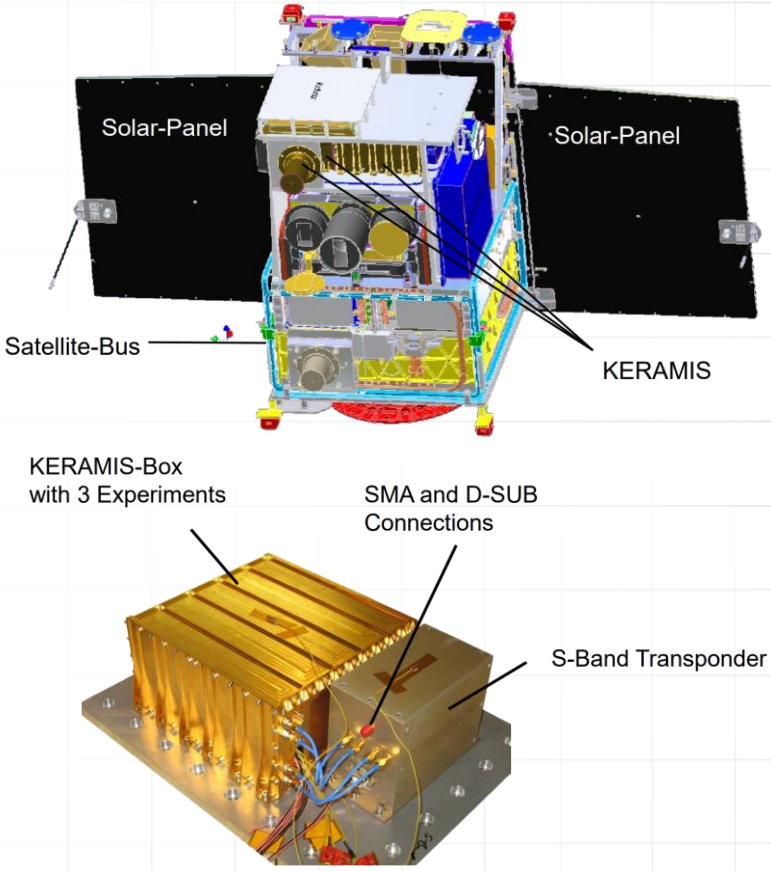


Transceiver
TU-Hamburg-Harburg

I. Wolff, R. Kulke, T. Klein, "LTCC: A Space Qualified Integration and Packing Technology for Millimeter-Wave Systems,",IEEE International Microwave Symposium 2012, Montreal, Canada

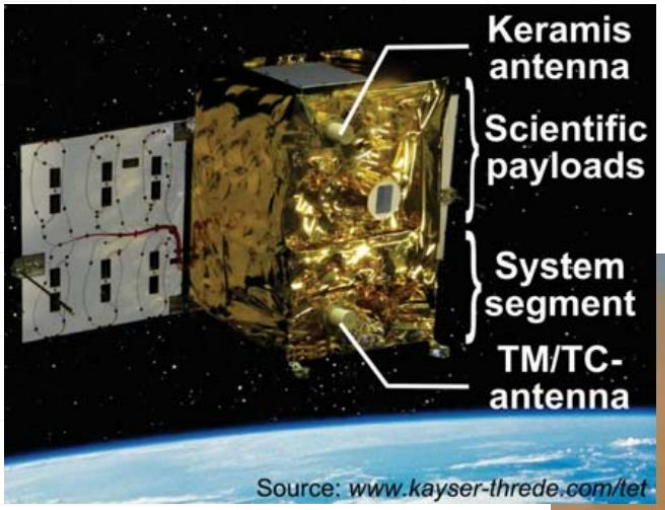
SPACE LTCC





I. Wolff, R. Kulke, T. Klein, "LTCC: A Space Qualified Integration and Packing Technology for Millimeter-Wave Systems,",IEEE International Microwave Symposium 2012, Montreal, Canada

SPACE LTCC



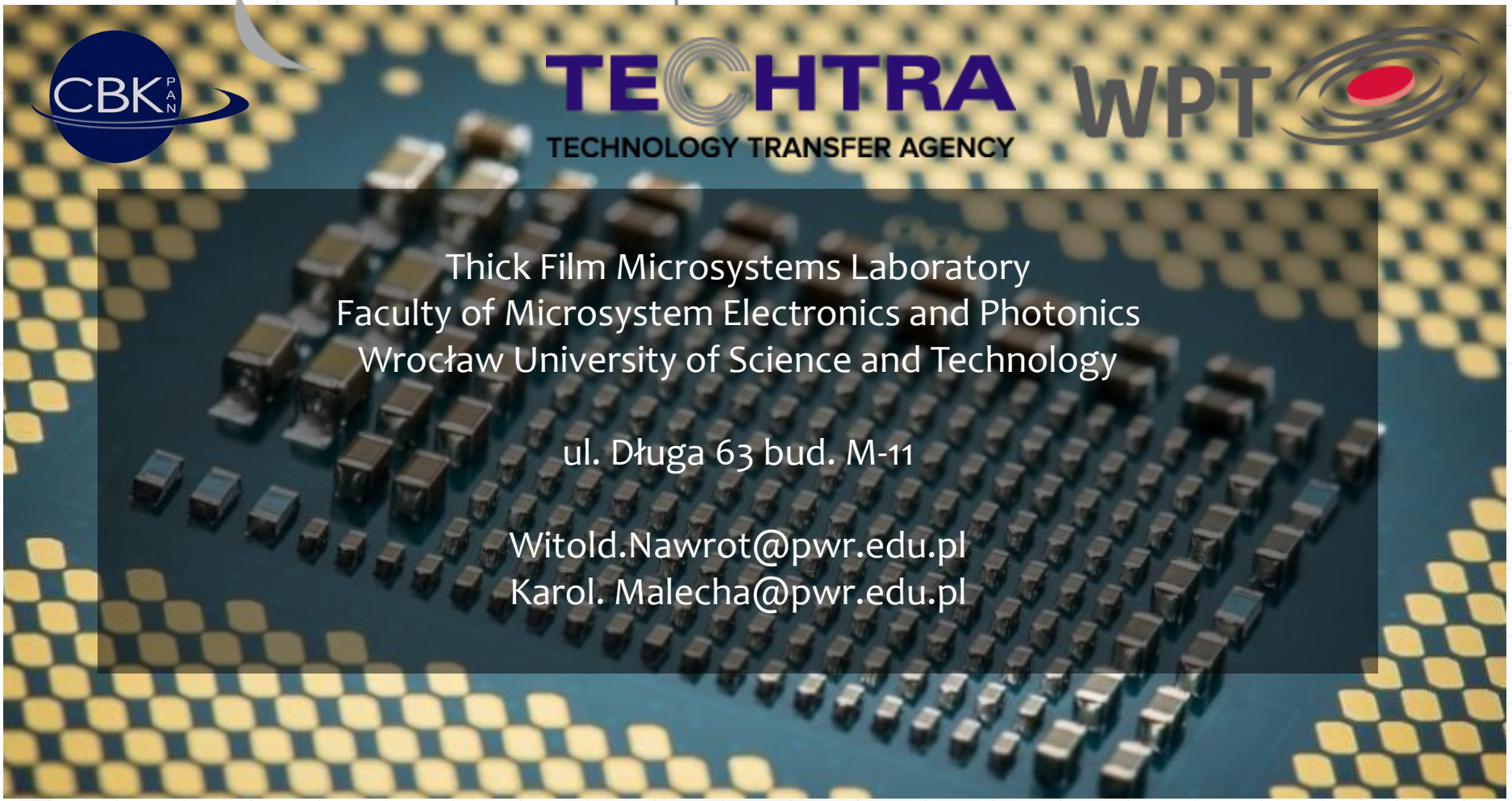
Source: *www.federalspace.ru*

SUMMARY

- LTCC provides superior performace to PCB laminates
- Multilayer compact devices with fine interconnections can be developed using this technology
- Fine spatial structuration is possible, which enables development of microfluidic devices
- Wide range of sensors and actuators can be integrated
- Complex systems can be developed using this technology

The National Centre for Research and Development

Research is funded by The National Centre for Research and Development grant no. POIR.04.01.02-00-0080/17-00



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