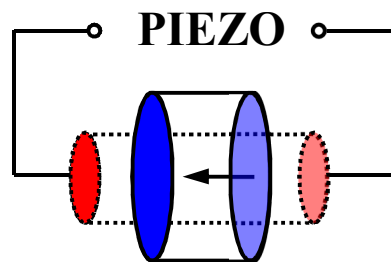


# Technical University of Liberec

## Piezoelectricity Research Laboratory



### ACTIVITY REPORT 2012-2018

**Contact:**

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## **Introduction**

During 2016 year laboratory equipment moved to storage and experimental work could not been performed until 2018 when it moved back to renovated laboratory space.

## **Field of research**

Piezoelectric transformers belong to the main applications studied in the laboratory – disc, bar, ring and plate shaped transformers working in contour extensional vibration modes with various electrode pattern. Attention has been payed to electromechanical properties of PZT ceramics and poling parameters. Student thesis and projects on various educational topics were performed in the laboratory.

## **Academic staff**

Jiří Erhart

Part time - Stanislav Panoš (left 2016)

## **Students**

J. Dlouhý, A. Šáfrová, V. Kučera, Z. Meloun, P. Valenta, T. Malysh

## **Grant projects**

Grantová agentura ČR, P102/10/1139 Piezoelektrické transformátory, jejich design a parametry, 2010-2012, investigator: J. Erhart.

Grantová agentura ČR, 18-20498S Control of microstructure and properties of lead-free piezoceramic materials through advanced ceramic processing, 2018-2020, investigator: K.Maca (CEITEC Brno) and J. Erhart.

## **Participation on other projects**

Grantová agentura ČR, P204/10/0616 Moderní piezoelektrické perovskity: kmity krystalové mřížky a doménové stěny, 2010-2012, investigator: J. Hlinka (FzÚ AVČR Praha), P. Mokřý (FM TUL); collaboration: J. Erhart, M. Šulc, S. Panoš.

## **Dissertations, Diploma, Bachelor and Project Thesis**

### **Ph.D. Theses (in Czech)**

T. Malysh: Poling of PZT ceramics, TU Liberec 2012

### **Diploma Theses (in Czech)**

V. Kučera: Polarizace světla, TU Liberec 2016

Z. Meloun: Nanovláknenný generátor elektrické energie, TU Liberec 2018

### **Bachelor Theses (in Czech)**

P. Valenta: Měření Curieovy teploty feroelektrických látek, TU Liberec 2014

A. Šáfrová: Elektromagnetická indukce, TU Liberec 2015

J. Dlouhý: Permanentní magnety, TU Liberec 2017

## Books and book chapters

J.Erhart, P.Půlpán, M.Pustka: Piezoelectric ceramic resonators, Springer International Publishing Switzerland 2017, ISBN 978-3-319-42480-4

## Publications

J.Erhart, W.Cao: Three Dimensional Domain Structures for Domain Engineered Rhombohedral Perovskite Ferroelectric Crystals, *Ferroelectrics* **426** (2012) 13-20

J.Erhart, P.Půlpán, R.Doleček, P.Psota, V.Lédl: Disc piezoelectric ceramic transformers, Proceedings of 2012 21st IEEE Int. Symp. on Applications of Ferroelectrics held jointly with 11th IEEE European Conference on the Applications of Polar Dielectrics and IEEE PFM, ISAF/ECAPD/PFM 2012, art. no. 6297859

P.Psota, V.Lédl, R.Doleček, J.Erhart, V.Kopecký: Measurement of piezoelectric transformer vibrations by digital holography, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* **59**, 9 (2012) , art. no. 6306016, pp. 1962-1968

L.Kozielski, M.Adamczyk, J.Erhart, M.Pawelczyk: Application testing of Sr doping effect of PZT ceramics on the piezoelectric transformer gain and efficiency proposed for MEMS actuators driving, *Journal of Electroceramics* **29**, 2 (2012), pp. 133-138

L. Kozielski, J. Erhart, F. J. Clemens: Light-Intensity-Induced Characterization of Elastic Constants and  $d_{33}$  Piezoelectric Coefficient of PLZT Single Fiber Based Transducers, *Sensors* **13**, 2 (2013) 2419-2429

J.Erhart: Bulk piezoelectric ceramic transformers, *Advances in Applied Ceramics* **112**, 2 (2013) 91-96

J.Erhart: Experiments to demonstrate piezoelectric and pyroelectric effects, *Phys. Educ.* **48**, 4 (2013) 438-447.

J.Erhart, P.Půlpán, L.Rusin: Bar Piezoelectric Ceramic Transformers, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* **60**, 7 (2013) 1479-1486

J.Erhart, P.Půlpán, R.Doleček, P.Psota, V.Lédl: Disc Piezoelectric Ceramic Transformers, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* **60**, 8 (2013) 1612-1618

M. Šimko, J. Erhart, D. Lukáš: A mathematical model of external electrostatic field of a special collector for electrospinning of nanofibers, *Journal of Electrostatics* **72**, 2 (2014) pp.161–165

J. Erhart: Measurement of elastic modulus and ultrasonic wave velocity by piezoelectric resonator, *European Journal of Physics* **36**, 1 (2015) 015017

C. Nadal, F. Pigache, J. Erhart: Modeling of a Ring Rosen-Type Piezoelectric Transformer by Hamilton's Principle, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* **62**, 4 (2015) 709-720

T. Sebastian, L. Kozielski, J. Erhart: Co-sintered PZT ceramics for the piezoelectric transformers, *Ceramics International* **41**, 8 (2015) 9321-9327

J. Erhart: Parameters and design optimization of the ring piezoelectric ceramic transformer, *Journal of Advanced Dielectrics* **5**, 2 (2015) 1550022

J. Erhart, T. Sebastian: Effective Electromechanical Coupling for the Partially Electroded Ceramic Resonators of Different Geometries, *THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI. FASCICLE IX. METALLURGY AND MATERIALS SCIENCE*, Vol. **XXXIII**, No. 2 (2015) 7-16, ISSN 1453 – 083X

T. Sebastian, J. Erhart: Bar Piezoelectric Ceramic Transformers Working in Longitudinal Mode, *Ferroelectrics* **486**, 1 (2015) 13-24

P. Půlpán, J. Erhart: Experimental Verification of an Analytical Model for the Ring-shaped Piezoelectric Transformer, *Journal of Electrical and Electronics Engineering* **8**, 2 (2015) 23-28

J. Erhart: Transformation and Load Parameters of the Disk Piezoelectric Transformer, *IEEE Transactions on Power Electronics* **31**, 3 (2016) 2437-2442

B. Wodecka-Dus, L. Kozielski, J. Erhart, M. Pawełczyk, D. Radoszewska, M. Adamczyk, D. Bochenek: Investigation of La<sup>3+</sup> doping effect on piezoelectric coefficients of BLT ceramics, *Arch. Metall. Mater.* **62**, 2 (2017) 691-696

P. Půlpán, J. Erhart: Width-Extensional Piezoelectric Ceramic Transformer, *Journal of Electrical and Electronics Engineering* **11**, 2 (2018) 21-26

Vijay Bijalwan, Pavel Tofel, Jiří Erhart, Karel Maca: The complex evaluation of functional properties of nearly dense BCZT ceramics and their dependence on the grain size, *Ceramics International* **45**, 1 (2019) 317–326

### **In Czech**

J. Erhart, P. Desenský: Demonstrujeme teplotní vodivost, *Matematika – fyzika – informatika* **22**, 5 (2013) 281-287

J. Erhart, L. Rusin, P. Hána: Měříme součinitel tepelné vodivosti kovů, *Matematika – fyzika – informatika* **22**, 4 (2013) 355-361

J. Erhart: Měříme rezistivity kovových drátů a závislost odporu vodiče na jeho délce a průřezu, *Matematika - fyzika - informatika* **24**, 1 (2015) 26-34

J. Erhart, M. Pustka, P. Půlpán: Aplikace piezoelektrických prvků v mechanických a akustických soustavách, VÚTS, a.s., Liberec 2015, ISBN 978-80-87184-57-8

Kapitoly – J. Erhart: Piezoelektrika-historie výzkumů,

J. Erhart: Piezoelektrické materiály,

P. Půlpán, J. Erhart: Piezoelektrické transformátory

J. Erhart: Tvarová paměť chytrých materiálů, konference Veletrh nápadů učitelů fyziky,

Brno 26. - 28. 8. 2016 (sborník: MUNI Brno a JČMF, Brno 2016, editoři T.Milář, J.Válek,  
ISBN 978-80-210-8465-0, str. 46-51)