

# **2010 Symposium on Piezoelectricity, Acoustic Waves and Device Applications**

## **(SPAWDA 2010)**

**Xiamen, China  
10 – 13 December 2010**



IEEE Catalog Number: CFP1025F-PRT  
ISBN: 978-1-4244-9822-2

## Contents

<b>From the Chair .....</b>	iii	
<b>From the Editors .....</b>	iv	
<b>Committees .....</b>	v	
<b>List of Invited Plenary Talks .....</b>	viii	
<b>List of Winners of Student Paper Competition.....</b>	ix	
<b>Contents .....</b>	xi	
Detecting cavitation signals based on ultrasonic acoustic emission technology .....		
.....Jian-xin Wang, Mei-li Sui, Shi-feng Yang, Xian-wei Gao	1	
Investigation of the temperature dynamics process in the nonlinear optical materials by using PO Z-scan technique..... Shu-guang Dong, Jun-yi Yang, Min Shui, Chuan-xiang Yi, Zhong-guo Li, Ying-lin Song	6	
Experimental study of mode conversion in pipes on damage detection by using longitudinal ultrasonic guided.....Zhen-hua Song, Feng Liu, Hong-wei Ma	11	
Thermo-electro-elastic waves in pyroelectric media.....Zhen-bang Kuang, Xiao-guang Yuan	16	
Study on graphical electro-spinning of PZT nano-fibers ..... Qiang Pei, Jian-lai Guo, Ye Tao, Hang Guo	21	
Cryogenic Temperature performance of traveling wave ultrasonic motor .....		
.....Xiao-long Lu, Jun-hui Hu, Chun-sheng Zhao	26	
The effect of the size of piezoelectric element on shear stress at the interface of deicing system .....		
..... Ning Li, Jun-hui Hu, Wei-qing Huang, Chun-ling Zhu, Chun-sheng Zhao	32	
Acoustic character analysis of MEMS ultrasonic device for micro/nano particles separation.....		
..... Hui Yang, Qi Liu, Hang Guo	36	
Research on the applications of dielectric ceramic in microwave oven .....		
..... Tong-zan Liu, Rong Huang, Fen Xiao	41	
Investigations on effects of free-stream Mach number on flow and aeroacoustic characteristics in cavity .....		
.....Dang-guo Yang, Jin-min Liang, Jian-qiang Li, Xin-fu Luo	46	
Analysis of monolithic quartz plate thickness-twisted mode acoustic wave filter .....		
..... Xin Yin, Jian-ke Du, Ji Wang, Jia-shi Yang	51	
Love wave propagation in a piezoelectric material structure with a mass layer .....		
..... Liang-fa Yan, Jian-ke Du, Ji Wang	55	
Multi-channel waveguides based on two dimensional phononic crystals .....	Xin Zhang, Fu-gen Wu	60
Fast washing micro-reactor on piezoelectric substrate based on surface acoustic wave .....		
..... Yi-qing Wei, An-liang Zhang	64	
Generation of droplets for lab-on-piezoelectric-substrate utilizing surface acoustic wave .....		
..... An-liang Zhang, Yi-qing Wei	68	
Friction and wear test device of liner ultrasonic motor and experimental studies.....	Jie Zhang, Zhi-yuan Yao	72
Study on acoustic bandgaps in two-dimensional square phononic crystals with cross-like holes.....		

.....	Yan-Feng Wang, Yue-Sheng Wang	78
Surface acoustic eaves in an infinite plate covered by a viscoelastic layer .....	Rong-xing Wu, Ji Wang, Jian-ke Du	83
Influence of porosity on properties in fluorocarbon piezoelectrets .....		
..... Ke-xing Lou, Xiao-qing Zhang, Gong-xun Cao, Zhuan-lan Sun, Zhong-fu Xia		89
Constitutive relation of electric fatigue on the ferroelectric ceramics .....		
..... Zhi-dong Zou, Feng-juan Yang, Ting-qian Liu, Ying Zhang , Quan Jiang, Chun-zu Zhang		95
PVDF energy harvester on flexible rings .....	Shun-di Hu, Kuo-chih Chuang, Horn-sen (H.S.) Tzou	100
Signal analysis of flexoelectric transducers on rings.....	Shun-di Hu, Horn-sen (H.S.) Tzou	106
Distributed energy harvesting of $Z_nO$ nano-shells.....	Shun-di Hu, Hornsen (H.S.) Tzou	112
The study of activation energy (EA) by aging and high temperature storage quartz resonator's life evaluation .....		
..... Chun-nan Shen, Xiao-wei Yang, Colin Chang, Min-chiang Chao		118
Face-shear vibration of AT-cut quartz plate.....Qiaoqiao Pan, Ji wang, Lijun Yang, Min-Chiang Chao		123
Investigation of actuating characteristics of laminated PVDF actuator used on paraboloidal shells .....		
..... Ya-hong Zhang, Xi-nong Zhang		128
Two-scale asymptotic errors analysis for piezoelectric problem in periodic structure of composites.....	Yong-ping Feng, Ming-xiang Deng	134
Energy harvesting using a circular cylindrical shell laminated with a segmented piezoelectric layer .....		
..... Xin Li, Kuo-chih Chuang, Horn-sen (H.S.) Tzou		139
Fabrication and piezoelectric property characterization of a novel mico/nano PZT epoxy 1-3 composite.....		
..... Cai-feng Chen, Xiao-Li Han, Jun Liu, Ying Luo		145
Calculation of three-dimensional phononic band structures using the combined method of FDTD and filter diagonalization .....	Xiao-xing Su, Tian-xue Ma, Yue-sheng Wang	149
The design and characteristic analysis of grating transducer for vibration detecting .....		
..... Zhong-liang Nan, Ling Xiao, Jian-liang Li, Shu-qing Li		153
Lanthanide ion dopant effect on the phase transformation in ultrasonic assistant sol-gel derived titania nanostructures .....	Cheng Hu, Yue-tao Yang, Hao Yang, Xiao-jun Liu, Shu-yi Zhang	158
A study on the ultrasonic preparation of nanocrystalline zinc oxide in room temperature ionic liquid and triethylene glycol .....	Hao Yang, Hai-yan Wang, Yue-tao Yang, Xiao-jun Liu, Shu-yi Zhang	162
Sound transmission loss characteristics of single corrugated panel .....		
..... Shi-lin Xie, Sheng-jiang Liu		166
A compact ultrasonic motor using two in plane modes..... Yin Wang, Jiamei Jin, Weiqing Huang		171
A cymbal pressure-gradient vector hydrophone using PMNT single crystal .....		
..... Yi-long Yin, Jun-bao Li, Jian-xin Xing, Jin-dong Xia, Ke-jia Lü		175
Design principle and experiment of gradient friction material for ultrasonic motor .....		
..... Yan-li Wanng, Jian-jun Qu, Ning-ning Zhou, Wei-ling Cui		180
Application research on diseases stressed plant based on near-field acoustic holography.....		
..... Xiu-qing Wang, Jing-ya Zhang, Yu-liang Liu		185
High Curie temperature piezoelectric single crystals $Pb(In_{1/2}Nb_{1/2})O_3$ - $Pb(Mg_{1/3}Nb_{2/3})O_3$ - $PbTiO_3$ and their applications in medical ultrasonic transducers..... Wei Wang, Yaoyao Zhang, Xiangyong Zhao, Haosu Luo		191

Study on the equivalent circuit of a microfabricated ultrasonic micro-knife and PZT driving power .....	Jing Wu, Hang Guo	196
Strength monitoring of concrete based on embedded PZT transducer and the resonant frequency .....	Dan-sheng Wang, Liang-ping Yu, Hong-ping Zhu	202
Leakage forecasting for water supply network based on GA-SVM model .....	Xiang-ming Gao, Shi-feng Yang, Yu Hu	206
Properties of CE-coated BaTiO <sub>3</sub> based ceramics .....	Hao-feng Zhao, Ling Wang, Lu Zhang, Mei-ling Liu	210
Study on detection of vibration of a microfabricated ultrasonic micro-knife.....	Jiashan XU, Hang GUO	213
Characterizations of Nb <sub>2</sub> O <sub>5</sub> modified PZT piezoelectric ceramics and feasibility study for acoustic sensor .....	Bing-Huei Chen, Long Wu, Jia-Bin Wang, Ching-Chou Su, C.C. Tai, J.F. Chen	217
Indentation on piezoelectric films in smooth contact with an elastic substrate.....	Ye-fei Wu, Hsiang-yung Yu, Wei-qi Chen	221
Static control of cylindrical shells .....	Zheng Rao , Hornsen (H.S.) Tzou	226
The basic research of criss-cross rotatable varifocal mechanism.....	Liang Wang, Xue-fei Leng, Rong Yan, Bi-hui Wang	231
Computation of the acoustic radiation force on a aphere based on the 3-D FDTD method.....	Xin Cheng, Fei-yan Cai, Long Meng, Hai-rong Zheng	236
Reverber-ray analysis of dispersion of elastic waves in a box-girder.....	Ji-qing Jiang, Gui-ru Ye, Wei-qi Chen	240
The analysis of environmental temperature's effects of ultrasonic motor's dynamic characteristics .....	Ru-huan Chen, Chao Chen, Kang Yang	244
Synthesis of sodium-potassium niobate (K, Na)NbO <sub>3</sub> Lead-free piezoelectric powders using solvothermal and hydrothermal processing .....	Ji-lan Yang, Hai-yan Chen, Zhuo Wang	249
Characteristics of PZT-driven dual synthetic jets actuator and numerical simulations of thrust vectoring .....	Zhen-bing Lou, Lin Wang, Deng-pan Wang, Zhi-xun Xia	254
Transient response of composite beams with partial interaction .....	Xu-dong Shen, Wei-qi Chen, Rong-qiao Xu	259
Piezothermoelastic analysis of thin films deposited on elastomeric substrates .....	Dong-ying Liu, Wei-qi Chen	265
Researches on frequency tracking technology of utrasonic motor .....	Jing-song Zeng, Wen-hua Luo, Xiang-hong Lei	270
Affects of pre-pressure on ultrasonic motor output performance .....	Jing-song Zeng, Wen-hua Luo, Jin-xin Lei	275
Finite-difference time-domain modeling of acoustic propagation in piezoelectric media .....	Xiao-li Yu, Ming Cao, Zhong-yong Luo, Xun Gong, De Zhang	280
Calibration of piezoelectric AE sensor sensitivity for longitudinal wave.....	Ying Li, Long-biao He, Hai-jiang Zhu	285
Modeling and simulation of a new piezoelectric stack actuator with bi-direction outputs.....	Ya-jun Luo, Ming-long Xu, Xi-nong Zhang	290

Vibration spectrum of piezoelectric ceramic resonator with different diameter-to-thickness ratio .....	Ming-cheng Chure , Long Wu, King-kung Wu, Bing-huei Chen, Ping-cheng Chen	296
An integrated program of vibrations of quartz crystal plates with Mindlin plate theory for resonator design.....	Ji Wang, Yu-mei Chen, Li-jun Yang, Qiao-qiao Pan, Min-Chiang Chao	300
Mechanical properties of ferroelectric 180 degree domain structure under different strain rates .....	Xiao-bao Tian, Xin-hua Yang, Wei-zhong Cao	306
Fabrication of PZT by sol-gel method .....	Bing-Huei Chen, Long Wu, Ming-Cheng Chure, Yeong-Chin Chen	310
The bending problem of piezoelectric micro-beam based on micromorphic electroelastic theory .....	Wei-zhong Cao, Xin-hua Yang, Xiao-bao Tian	315
Elastic waves in piezoelectric cylinders with sectorial cross-section.....	Yun-ying Zou, Wei-qi Chen, Chao-feng Lü	319
Two-dimensional exact analysis of piezoelectric curved beam within symplectic framework .....	Li Zhao, Wei-qi Chen	325
A novel approach of maximizing code capacity in SAW-based RFID systems .....	A-long Kang, Tao Han, Yong-an Shui	331
Design and realization of narrow quartz crystal filter at 70MHz .....	Qing-li Li	337
Finite element design of a new piezoelectricity bender disk transducer array .....	Kuan Li, Yu Lan, Wei Lu	341
Extraction of COM parameters from field distribution .....	Xiang-long Shi, Xiao-yang Chen, Hao-Wang, Hao-dong Wu, Yong-an Shui	345
Shape reconstruction of flaws using modified Bron approximation in inhomogeneous material .....	Gang-feng Zheng, Bin Wu, Cun-fu He	350
Design and test of a novel piezoelectric stack pump.....	Xin Yuan, Jin-hao Qiu, Hong-li Ji, Jia Sun, Tao Qiu	354
Model experiments of damaged structural identification based on electro-mechanical impedance technique .....	Jin-biao Cai, Tao Wu, Yong Chen	360
A design of honeycomb sandwich based on piezoelectric fiber composites .....	Rui Nie, Jin-Hao Qiu, Hong-Li Ji	366
Recursive formulations for dynamic analysis of a smart cracked beam based on the method of reverberation-ray matrix .....	Wei Yan, Jin-biao Cai, Wei-qi Chen, Ji Wang	371
Experimental investigation on ultrasonic levitation of gyroscope.....	Fan Li, Chao Chen, Bing Jia	377
Analysis of effect of teeth on disk stator dynamics of traveling wave rotary ultrasonic motor.....	Chao Chen, Fan LI, Ru-huan Chen	383
Dynamic analysis and design of a ultrasonic/sonic drilling device .....	Kang Yang, Chao Chen	387
Theory and experiment of the valveless piezoelectric pump using tubes with combined shape of 'Y' and cone .....	Jun Huang, Jian-hui Zhang	392
Wide bandwidth ultrasonic transducer design using a lumped oscillation coupled model.....	Yeong-chin Chen, Menq-jion Wu, Jing-min Lin	397
Green's function for scattering of SH waves by elliptical cavity in half-space.....	Zai-lin Yang, Hua-nan Xu, Kui Jiang, Bai-tao Sun	403
Effect of a viscous liquid layer on the transverse surface waves in transversely piezoelectric materials with unattached electrode.....	Feng Jin, Peng Li, Zheng-hua Qian	409
Analytical solution for functionally graded piezoelectric cantilever beam subjected to thermal and		

transverse loading .....	De-jin Huang, Ji Wang	413
Nonlinear dynamic behaviors of piezoelectric plate vibration .....		
..... Yu Zhang, Fu-qiang Niu, Gong-huan Du, Yan-ming Yang, Wen-huan Jiang	418	
Experimental research on nonlinear coupling between two sides of rectification in piezoelectric energy harvester..... Huan-huan Gu, Di Ma, Shu-yi Zhang, Li-ping Cheng, Xiu-ji Shui	424	
The propagation of Lamb waves in a one-dimensional phononic crystal plates bordered with symmetric uniform layers .....	Jiu-Jiu Chen, Xu Han	428
The finite element analysis on frequency shift of a piezoelectric plate operating in the thickness-shear mode under biasing fields .....	Xing-ye Shan, Hong-ping Hu, Huan Xur, Yuan-tai Hu	432
The inverse of material properties of functionally graded plates based on the guided waves..... Jian-gong Yu, Wei-qiang Ma	436	
Subdomain collocation method for multilayered piezoelectric material .....		
..... Xue-shuai Yuan, Fu-jun Chen, Lin-quan Yao	441	
Working mechanism of a novel linear piezo-stack motor .....		
..... Xi-fu Chen, Jing-jing Xu, Yin Wang, Wei-qing Huang	447	
Dielectric and piezoelectric properties of lead-free $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{TiO}_3$ - $(\text{K}_{0.5}\text{Bi}_{0.5})\text{TiO}_3$ - $(\text{Li}_{0.5}\text{Bi}_{0.5})\text{TiO}_3$ ceramics with $\text{Ba}^{2+}$ and $\text{Ca}^{2+}$ doped .....		
..... Ling-juan Fei, Jun Liu, Yue-ming Wang, Wo Tian, Cai-feng Chen, Hong-ye Geng, Ying Luo	451	
A MEMS lamb wave microdevice nased on ZnO thin film .....		
..... Meng-wei Liu, Ming-xin Xue, Jun-hong Li, Xin Li	455	
Analysis of frequency-temperature behavior of surface acoustic wave (SAW) under periodic IDT .....		
..... Wei-biao Wang, Kang-jun Tang, Hao-Dong Wu	460	
Ultrasonic motors using shear-type piezoelectric ceramics..... Cun-yue Lu, Jin-liang Li, Wen-yuan Pi	465	
Distributed sensor signal analysis of double-curvature piezoelectric laminated thin shell based on finite difference .....	Lei Wang, Bing-yin Ren, Horn-sen Tzou, Hong-hao Yue	470
Vibration analysis of layered film bulk acoustic resonators..... De-jin Huang, Ji Wang	475	
Influences of poling direction and boundary conditions on cracks in 2D piezoelectric media .....		
..... Cui-ying Fan, Ming-hao Zhao	479	
Transmission of elastic and acoustic waves propagating in phononic crystals analyzed by a boundary element method..... Feng-lian Li, Yue-sheng Wang, Chuan-zeng Zhang	485	
Simulation of ZnO based film bulk acoustic resonator by modified Butterworth-Van Dyke model..... Zhi Yan, Xiao-jie Zhou	491	
The absorption characteristics of anechoic coating embedding mixed-cavity structure with single or double shell backing .....	Chao Shang, Ying-jie Wei, Jia-zhong Zhang	497
Resonant frequency tunableness of solidly mounted resonators .....	Chien-hao Liu, Yuan-fang Chou	501
A SAW-based $\text{H}_2\text{S}$ sensor coated with $\text{SnO}_2$ thin film .....		
..... Hong-lang Li, Xiu-dong Wang, Shi-tang He, Qiu-yun Fu, Wei Luo, Dong-xiang Zhou	507	
HRBF meshless method for buckling analysis of piezoelectric laminate plates .....		
..... Lin-quan Yao, Fu-jun Chen, Xin Liu	511	
Study on thickness detection of industrial pipe network by high-frequency ultrasound .....		

.....	Ji-min Zhao, Shi-feng Yang, Yang Li, Xiu-qing Wang	517
The research of acoustic wave non-destructive examination technology for anchoring quality of anchored bolt....		
.....	Ji-min Zhao, Shi-feng Yang, Pei-cheng Tang, Xiu-qing Wang	522
The finite element analysis of thickness-shear vibrations of quartz crystal plates with ANSYS .....		
.....	Ji Wang, Jun Shi, Jian-ke Du	527
A Love wave biosensor using aptamer sensitive layer .....		
.....	Li-na Cheng, Hong-lang Li, Yong Liang, Shi-tang He, Zhao-yang Tong	532
Fabrication technology and properties of rare earth giant magnetostrictive films based on MSAW application ....		
.....	Si-he Chen, Bai-yang Zhou, Bin-yi Zheng, Deng-yang Wu, Liang-qi Lin, Mei Lin	536
Analysis and simulation of natural frequency for the MSAW-oriented RGMFS sample.....		
.....	Bai-yang Zhou, Si-he Chen, Liang-qi Lin, Deng-yang Wu	542
Electromechanical behavior of a piezoelectric plate lying on a viscoelastic foundation.....		
.....	Xing-yuan Miao, Guo-qing Li, Xiao-ran Yin, Wei Xu	547
Analysis of beams with piezoelectric stack by using finite element method and impedance method.....		
.....	Xiao-ran Yin, Guo-qing Li, Wei Xu, Ying-yuan Miao	554
Vibration analysis of thin plate actuated by piezoelectric element using finite element method and impedance method .....		
.....	Wei Xu, Guo-qing Li, Xiao-ran Yin, Xing-yuan Miao	559
Investigation of langanite and langatate single crystals for high temperature sensing.....		
.....	Fa-peng Yu, Duo-rong Yuan, Xian Zhao, Shu-jun Zhang	564
Study on bending problems of piezoelectric laminated plates with an elliptic hole.....		
.....	Jian Qiu, Cun-fa Gao, Xiang-hua Dai	570
Design of microwave cavity for active hydrogen maser .....		
.....	Wen-ming Wang, Ke Dai, Yan-jun Zhang, Yi-dong Wu, Jun Liu, Hao Yang, Wei-qun Zhang	576
<b>Author Index</b> .....		580
<b>TXC (Ningbo) Corp</b> .....		585
<b>Rakon Crystal (Chengdu) Co., Ltd</b> .....		586
<b>East Crystal Electronic Co., Ltd</b> .....		587
<b>Pera Global</b> .....		588