Design and fabrication of Relaxor-PT single crystals-based devices

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After enhanced the piezoelectric performances of PMNT and PIMNT single crystals by AC poling technique, two kinds of relaxor-PT based 3MHz phased array transducers have been designed by FEM simulation with PizeoFlex, then they have been fabricated with well performances, one has got the bandwidth 91.41%@-6dB and insertion loss -45.5dB by using three matching layers, anther has got the bandwidth 88.12%@-6dB and -32.46 by using de-matching layers, much higher performances compared with conventional PZT transducers. These single crystal transfers have higher resolution, deeper penetration depth for medical ultrasound imaging.

By doing Mn2+, the comprehensive pyroelectric and dielectric performances of PMNT and PIMNT single crystals have been enhanced for 12×10-4Cm-2K-1 pyroelectric coefficient, 0.05%@1kHz dielectric loss, and 40.2×10-5Pa-1/2 FOM for detectivity (Fd), much higher pyroelectric performances than conventional LiTaO3 single crystal. Novel single element detector, and dual compensated pyroelectric detectors have been fabricated with detectivity D\*～2×109 cmHz1/2/W@5Hz, 6 times higher than conventional LiTaO3 pyroelectric detector. Based on the novel pyroelectric detectors, NDIR gas detectors have been designed and fabricated to measure the concentration of various gases, such as CO2 CO and CH4 .

ME composite PMNT/Metglas has been fabricated with ME charge coupling αQ~6200pC/Oe，capacity Cp~399pF，dielectric loss D~0.5%. Based on ME composite，ME magnetic sensors were designed and fabricated with the performances of sensitivity 0.8 pT/Hz1/2@1Hz, 0.2pT/Hz1/2@100Hz, 9fT/Hz1/2@EMR, power 20mW, and bandwidth 0.1Hz~15kHz, which are much better than conventional flux gate. Such novel magnetic sensors could be used in many area for sensing magnetic field.

A brief biography:

Dr. Haosu Luo, professor, and the group leader of ferroelectric single crystals and devices at Shanghai Institute of Ceramics, Chinese Academy of Sciences. He has significantly contributed to the growth and development of piezoelectric single crystals, especial for the growth and practical application of PMN-PT single crystals in the world. Current researches involve the growth of high-Tc relaxor-based single crystals, lead free piezoelectric single crystals, and their device applications on ultrasonic transducers, infrared detectors, ME magnetic sensors, and various device applications. He is a pioneer in the world for the single crystal growth of piezoelectric materials and devices fabrication. He has developed many innovative technologies for the growth and application of PMN-PT single crystals. He has involved more than 700 publications. He was nominee of EEE-UFFC Ferroelectrics Recognition Award in 2014 and 2015. He acquired the National Award for Technological Invention 2nd Prize in 2005, and the first prize of natural science of Shanghai municipal government in 2013.



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