

NAVY Transition Assistance Program

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NEED & CUSTOMER REQUIREMENT

Need: Concerted efforts to grow PMN-PT single crystal relaxor piezoelectrics in a variety of forms (bulk, multilayer, fibers, thin films, etc.) now yield materials in quantities and at a price, suitable for device prototyping; however, at this early stage of development, cutting, polishing and finishing is not fully developed, the machining can increase the final device cost by more than 50%.

Value to the Warfighter: The new compositional crystals and transducers can significantly enhance Navy sonar systems, i.e. to increase the source level, broaden bandwidth, higher operational temperature and more compact size for acoustic guidance and countermeasure systems.

Operational Gap: Legacy PZT ceramics give low energy conversion efficiency. PMN-PT piezoelectric crystals show lower operational temperature (<90C) and lower electrical coercive field, though coupling factor is above 90%. The new compositional crystal transducers give more than doubled coercive field, efficient energy conversion, and higher operational temperature (>120C). The new crystals are perfect for sonar projectors which performance is much better than PMN-PT crystals.

Customer Specifications: Technology is needed to control the surface perfection for reliable and reproducible manufacturing. Devise processing methods that control surface machining defects to reduce the manufacturing cost and to increase reliability of the final products.

Technology Description: A unique proprietary fabrication method and a system for crystal fabrication of lead indium niobate-lead magnesium niobate-lead titanate solid solution, $X^*[\text{Pb}(\text{In}_{1/2}\text{Nb}_{1/2})\text{O}_3] - y^*[\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3] - z^*[\text{PbTiO}_3]$, $x+y+z=1$, (PIN-PMN-PT). The systematic crystal fabrication system include platinum crucible fabrication, batch precursor preparation, crystal growth facilities, crystal boule mechanical finishing facilities, electroding and property characterization.

TECHNOLOGY DEVELOPMENT MILESTONES (SBIR/STTR)

Milestone	TRL	Risk	Measure of Success	TRL Date
First demonstration of low frequency projector using 36-shear mode PMN-PT crystals	4	Low	Test and comparison with calculated response	01/2008
Increase acoustic power density using PIN-PMN-PT crystals to build up 36-shear mode projectors	5	Low	Test under water	12/2009
Improved design and fabrication method that enhance the reliability and output	6	Low	Test under water	03/2010

Open contract: N00014-08-C-0060 ending 11/15/2009

N06-083 - H. C. Materials Corporation

Processing Methods to Fabricate Reliable Device Elements of PMN-PT Piezoelectric Single Crystals

SPONSORSHIP of original SBIR/STTR Topic

SYSCOM: ONR - SBIR

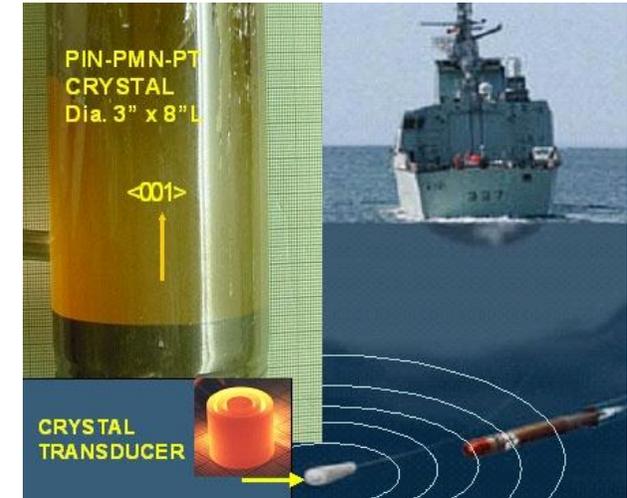
Transition Target: Navy SONAR Transducer for torpedo guidance and countermeasure

Original Sponsoring Program: Not Specified

TPOC Phone Number:
(703) 696-7021

Note:

The new ternary PIN-PMN-PT crystals with significantly increased coercive field and depoling temperature will improve the transducer robustness by allowing higher driving fields and higher operating temperatures.



TECHNOLOGY TRANSITION OPPORTUNITIES (PHASE III)

Other Potential Applications:

Torpedo guidance and countermeasure SONAR transducers
Radio sonobuoys (acoustic modem) and vector-sensors for accelerometers and hydrophones
Linear micro-polishing, e.g. deformable mirror control

Business Model:

H. C. Materials Corporation (HCMC) is a leader in the development and manufacture of high-performance single crystals, specializing in piezoelectric PMN-PT crystal products. HCMC is a rapidly growing manufacturer and supplies high quality piezoelectric crystal products for acoustic transduction devices such as actuators, sensors, ultrasonic imaging transducers, underwater acoustics, active vibration control, transformers, optics, and bulk acoustic wave devices for telecommunications.

Objective:

HCMC seeks to partner with Prime contractors to integrate crystals into transducers and other systems. To date over 35,000 PMN-PT crystal wafers have been supplied to more than 20 clients including Philips, GE and Raytheon.