



H. C. MATERIALS CORPORATION

NEXT GENERATION OF PIEZOELECTRIC CRYSTAL PRODUCTS

3-inch PMN-PT Crystal and (001)-Cut Wafers

About the Technology

To achieve efficient energy conversion and higher signal-to-noise ratios, the Navy seeks the next generation of piezoelectric crystals with improved electro-mechanical properties for use in SONARs, hydrophones, adaptive optics, and acoustic guidance and countermeasure systems. H. C. Materials Corporation (HCMC) developed a cost effective method, “Multi-crucible and seeded Bridgman growth associated with zone-leveling techniques”, to manufacture high quality PMN-PT (lead magnesium niobate-lead titanate) single crystals. The PMN-PT single crystal is formulated to exhibit high piezoelectric coefficient, large electric-mechanical coupling coefficient, high dielectric constants and low dielectric losses. Piezoelectric coefficient is generally higher than piezoelectric ceramics, which produces improved bandwidth, sensitivity, and source level in applications.

Current PMN-PT single crystals show super field-induced strains up to 1%, and large electro-mechanical coupling factors above 0.90. However, due to chemical segregation, growing the crystal in larger sizes has been difficult, without losing compositional homogeneity and property control. HCMC is able to routinely manufacture single crystals of more than 3” in diameter and 7” in length, weighing 6 kilograms. The company’s PMN-PT single crystals has been successfully commercialized for broadband transducers of medical ultrasound imaging system, e.g., Philips “pure-Wave” technology using the crystal transducer probes. As the core component used to achieve greater signal to noise ratios, energy conversion, and enhanced ultrasound for Navy SONAR systems, H.C. Materials received a contract to provide its 4 inch diameter single crystal for installation in SONAR transducers for torpedo guidance systems, radio sono-buoys, and vector-sensors.

Military and Commercial Significance

Incorporating PMN-PT crystals into Navy fleet provides high-energy density acoustic transducers for Navy SONAR systems, such as super high-sensitivity acoustic sensors for accelerometers, and deformable mirror control for missile guiding. The successful manufacture of PMN-PT crystals has enabled the development of the next generation of acoustic transduction devices for military and commercial application.

APPLICATIONS

- Navy:
 - Torpedo guidance and countermeasure sonar transducers
 - Radio sono-buoys (acoustic modem), vector-sensors for accelerometers and hydrophones
 - Linear micro-positioning, e. g. deformable mirror control
- Medical: Imaging Systems

About the Company

H.C. Materials Corporation (HCMC) is a leader in developing and manufacturing high-performance single crystals, specializing in PMN-PT crystal products for acoustic transduction applications. Prototype acoustic transduction devices that employ HCMC’s PMN-PT provides superior performance over any known piezo-electric materials such as piezo-electric ceramics. To date over 20,000 PMN-PT crystal wafers have been supplied to more than 20 clients including Philips, GE, and Raytheon. HCMC seeks to partner with prime contractors to integrate crystals into transducers and other systems.

Topic Number: 03SBI-0031
(ONR)

SBIR Investment: \$898K
Project Revenue: \$100M

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