An Update of Large Size Relaxor-PT Crystal Development at TRS

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Development of the relaxor-based ferroelectric crystals of $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PMN-PT) and $Pb(Zn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PZN-PT) represents a revolutionary advance for piezoelectric applications. These binary relaxor-PT crystals provide several key advantages over PZT ceramics, including high elastic compliances (4-5 times of PZT), large piezoelectric coefficients (3-5 times of PZT), and extremely high electromechanical coupling coefficients (k_{33}>90%). By B-site substitution, ternary crystals, such as $Pb(In_{1/2}Nb_{1/2})O_3$-$Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PIN-PMN-PT), and Mn doped ternary crystals, such as Mn:PIN-PMN-PT, have largely expanded the operational temperature and electric field. The piezoelectric applications based on relaxor-PT crystals, covering a broad range of transducers, sensors, and actuators, either have been commercialized or are in great interest of research.

Sponsored by Office of Naval Research (ONR) through SBIR and STTR programs, TRS Technologies Inc. has developed a serials of relaxor-PT single crystals for the naval sonar transducers and the medical ultrasound imaging transducers. Currently, 4in diameter, <001>-oriented PMN-PT and PIN-PMN-PT single crystals are commercially produced at TRS using a modified Bridgman method. This presentation reviews the recent progress on relaxor-PT single crystal development at TRS with a focus on growth of 5in diameter, <001>-oriented PMN-PT crystals by a modified Bridgman method.

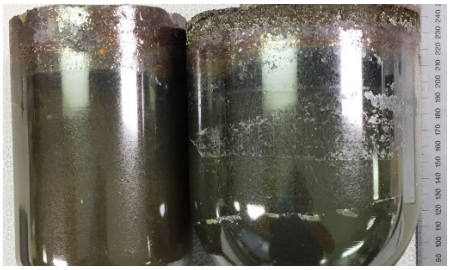

Figure 1. An as-grown ϕ4in (left) and ϕ5in (right) PMN-PT crystal boule