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**Advanced Single Crystal Piezoelectric Transducers for Naval
Sonar and Medical Ultrasound Applications**

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Single crystal piezoelectrics have received much attention due to their very high piezoelectric and electromechanical coupling coefficients. Naval sonar and medical ultrasound transducers, fabricated from this material, exhibit unprecedented increases in bandwidth, source level, and sensitivity compared to ceramic based devices. In this paper we report many new developments in the growth and manufacture of single crystals. These include increased diameter ($> 3''$) crystal boules, improved compositional uniformity, increased thermal stability, and minimized surface damage. Manufacturing improvements are being applied to a broad range of crystal transducer applications. For navy sonar systems, crystals are resulting in very high bandwidths ($> 100\%$) for transducer sizes that are $1/2$ the resonating length and $1/4$ the weight of ceramic counterparts with equivalent (or often lower) source level. Manufacturing improvements such as high tensile strength, achieved by precision polishing crystal surfaces, are enabling new transducer operational regimes not possible with ceramic. In particular, single crystal 1-3 composite projectors show promise for achieving high source level in a compact, integrated system designs. Single crystals are also enabling new applications in medical ultrasound including very broadband and extremely high frequency transducers. Further improvements are expected in the near future.