

High frequency ultrasonic transducers for industrial applications

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In recent years, there has been tremendous development in high frequency ultrasonic imaging (above 20 MHz) especially in medical applications. This development is also driving non-medical applications especially for the industry due to increased availability as well as pressure on cost of manufacturing. Typical industrial applications of high frequency ultrasound cover non-destructive testing (NDT) of weld joints, thickness measurement, delamination detection etc.

The paper discusses basic material technologies of high frequency ultrasonic transducers, including PZT (Lead Zirconate Titanate), single crystals (LiNbO₃) and composites. Specific aspects of the front-end electronics are discussed as well. Typical applications are presented in depth, together with new emerging technologies such as PZT thick film technology. Typically, PZT thick films are pad- or screen-printed on a curved ceramic substrate acting as integrated backing layer and providing mechanical pre-focus. Center frequency ranges between 8 MHz and 80 MHz. The devices are characterized by good sensitivity as well as high bandwidth. This technology has also been successfully applied to manufacturing of multi-element transducers, including linear and annular arrays.

The paper presents selected performance characteristics such as center frequency, bandwidth, and sensitivity of tested devices operating at 30 MHz as well as selected results of ultrasonic testing of weld joints. The results indicate that PZT thick film based transducers exhibit a performance comparable to single crystals (LiNbO₃) transducers enabling therefore high frequency industrial ultrasound at significantly lower cost.