Investigations of high-Performance Ultrasonic Transducers based on PMN-PT Single Crystals

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Ultrasonic transducers for NDE applications are commonly based on Lead Zirconate Titanate or PZT, an inor-ganic compound and ceramic perovskite material. Until now the advantages of PMN-PT are used in medical applications, but are not implemented in NDE. Lead Magnesium Niobate-Lead Titanate (PMN-PT) is well known for its high sensitivity and broad frequency spectrum. While conventional PZT materials have an elec-tromechanical coupling factor K33 (a measure of the conversion between electrical and acoustic energy) of about 0.72, PMN-PT materials reach peak values of more than 0.93. For applications with low signal ampli-tudes, high electronic noise and small transducer elements, the performance of ultrasonic probes can be signifi-cantly enhanced by using Lead Magnesium Niobate-Lead Titanate (PMN-PT) instead of PZT. This single-crystal material offers significantly better piezo parameters and leads to a higher sensitivity and larger band-width. There is a better depth resolution possible with this transducers as practical tests have shown. Similar to PZT it can also be fabricated in 1-3 piezo-composite technology. In a cooperation between Fraunhofer IKTS, iBULe Photonics, and IFU Diagnostic Systems, PMN-PT ultrasonic transducers are developed and optimized. The performance of phased array probes and single element transducers was measured by a so called PCUS® pro electronic front end from Fraunhofer and compared with equivalent PZT-based probes. As a result various single element and phased array transducers with improved performances are available for NDT of typical aer-ospace materials and applications.