

Piezoceramic PZT-4 Material Technology

Ferroelectric materials exhibit spontaneous polarization which can be oriented by application of external electric field. This forms the basis of ferroelectric non-volatile memory and transistor devices. Other related properties of these materials viz. piezoelectricity, pyroelectricity, and high dielectric constant, have been used in fabrication of SONAR systems, ultrasonic transducers, radio and communication filters, pyroelectric security surveillance devices, medical diagnostic transducers, stereo tweeters, buzzers, gas igniters, positive temperature coefficient sensors and switches, electro-optic light valves and thin film capacitors.

Ferroelectric materials have come into use as substitute to single crystals in various transducer applications due to their potentially low cost, ease of fabrication in various shapes and sizes and durability under adverse atmospheric conditions. History of field of ferroelectrics is dominated by materials based on two compositional systems viz. barium titanates and lead zirconate titanates (PZT), later being superior over former in many respects.

PZT materials exhibit different properties by variation in composition and also by modifying them with different dopants. They have high coupling coefficient and high permittivity. As a result of intensive and systematic experimental work spread over five decades, several distinct grades of hard and soft ferroelectric materials designated as PZT Type-4 (Navy-I), Type-5A (Navy-II), Type-8 (Navy-III), Type-5J (Navy-V), and Type-5H(Navy-VI) with extremely good electromechanical properties have been developed, standardized and are being produced as per need. PNS-PZT and PMN-PT are recent addition to the list.

PZT Type-4 has low dielectric loss, high mechanical quality factor (Q_m), reasonably good coupling coefficient and high mechanical and electrical strain properties. This material is suitable for high power ultrasonic applications, acoustic projectors etc. PZT materials can be processed in to various forms such as bulk ceramics, thin films, and fibres.

Among different shapes, PZT cylinders or rings are commonly deployed in SONAR & under water communication applications.

