



## Abstract

### 1-3 piezocomposites with crystallographically textured ceramic fibers and textured 0-3 piezocomposites with single crystal particles aligned under electric fields

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Since the introduction of piezocomposites with various connectivity over 45 years ago, research and development have primarily focused on three key applications: the use of 1-3 piezocomposites for underwater electroacoustic systems, 2-2 piezocomposites for medical ultrasound probes, and, more recently, 0-3 piezocomposites for energy harvesters and tactile sensors. In nearly all studies involving 1-3 piezocomposites, polycrystalline ceramic fibers with randomly oriented grains were utilized, while equiaxed ceramic particles were used as fillers in most cases in 0-3 piezocomposites.

However, it is well-known that polycrystalline materials with randomly oriented grains exhibit an average of their physical properties along different crystallographic directions. In contrast, single crystals of the same composition can exhibit significantly enhanced properties along specific crystallographic directions compared to their polycrystalline counterparts. Thus, textured piezoceramics were developed in bulk form and became commercially available within the last several years.

In parallel with studies on textured bulk ceramics, our group has pioneered novel techniques to fabricate grain-oriented and crystallographically textured lead-free piezoceramic fibers, specifically KSN and SBN, by combining alginate gelation with templated grain growth methods. Using these textured fibers, we have developed anisotropic 1-3 piezocomposites. More recently, our focus has shifted to the development of anisotropic 0-3 piezocomposites, utilizing anisometric (needle-like or plate-like) single crystal particles as the active piezoelectric filler. By deliberately aligning these particles along their axis of superior electrical properties using external forces—whether electrical, mechanical, or magnetic—we aim to significantly improve the performance of these composites. A detailed overview of these studies will be presented and discussed.

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