# From processing to function: PLLA piezoelectric platforms for biomedical applications

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Poly (lactic acid) (PLA) is widely recognized as one of the most commonly used polymers in additive manufacturing because of its favorable mechanical properties and excellent processability. At the same time, it has a well-established role in biomedicine, where it is used in sutures, implantable devices, and other medical products due to its biocompatibility and biodegradability. Beyond its conventional role as a structural biomaterial, PLA also holds considerable functional potential. In its stereochemically defined form, poly (L-lactic acid) (PLLA) has helical molecular conformation that enables piezoelectric behavior. When appropriately processed, its molecular and crystalline organization can be tailored to induce piezoelectric behavior, enabling the material to generate electrical signals under mechanical deformation. This is particularly attractive for biomedical applications, where electrical cues are closely involved in cell signaling, tissue regeneration, and wound healing.

Using processing as the key design parameter, we developed PLLA-based piezoelectric platforms across multiple material formats, including films, fibers, nanotextured substrates, and 3D-printed constructs. By controlling processing conditions and the resulting architecture, we achieve enhanced piezoelectric performance while preserving the advantages of PLLA as a biodegradable and biocompatible material. Importantly, these platforms are not only structurally versatile but also biologically active: we confirmed their compatibility with cells and demonstrated favorable bioactivity, while also observing antibacterial effects that we associate with their electrically active nature.

As resorbable systems, PLLA-based platforms can provide temporary stimulation and support during healing, and then gradually degrade as they are replaced by newly formed tissue. Altogether, our results position PLLA as a versatile piezoelectric biomaterial whose function can be tailored through processing for advanced biomedical applications.