Mechanical Stress-responsive Poly (L-lactic) Acid Platforms for Biomedical Applications

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Mechanical force has been proven to be able to control the electrical polarization state of inorganic ferroelectrics. Mechanical switching of polarization was shown possible for the first time in the nanoscale volume of an epitaxial single-crystalline ferroelectric BaTiO3 films. This opened exciting possibilities for novel data storage technologies, devices based on mechanical writing of the electronic signals and current-based readout. Mechanical writing of an electrical information in polymeric materials has also been successfully performed on ultra-thin films of ferroelectric copolymer of vinylidene fluoride and trifluoroethylene P(VDF-TrFE) for nonvolatile ferroelectric memory applications 6,7 but no reports yet on mechanical writing of an electrical polarization on medical grade biodegradable polymers, with potential to be used for regenerative strategies.
In this talk we report the production of poly(L-lactic acid) (PLLA) thin films that exhibit a mechanical stress responsive behaviour. We demonstrated for the first time the possibility of mechanically writing an electrical polarization in the biocompatible and biodegradable poly(L-lactic) acid. These mechanical stress-responsive PLLA platforms react to applied forces in the range of a cell sheet level, shear stress in blood vessels and fluid induced stresses in bone. The magnitude of this effect can be tuned by varying PLLA thickness and PLLA crystallinity. This opens a wide range of possibilities from energy harvesting to biomedical applications. In living tissues, as most mechanical stimuli will be transduced as strain gradient for the anatomical structures, such mechanical stress-responsive substrates can be used as platforms to understand protein adsorption and cell response**.**