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Piezoelectric actuator: Searching inspiration in nature for osteoblast stimulation

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Abstract

Bone is a composite with piezoelectric properties. Bone mass and structure are dependent on mechanical stress and adaptive response at cellular and tissue levels, but the role piezoelectricity plays in bone physiology is yet to be understood. Physical activity enhances bone density, through mechanical stimulation. Osteocytes and osteoblasts are essential for mechanosensing and mechanotransduction. Strategies have been tested for mechanical stimulation of cells and tissues in vitro. The aim of this work was to experimentally validate the use of piezoelectric materials as a mean of directly straining bone cells by converse piezoelectric effect. To estimate the magnitude of stress/strain, finite numerical models were applied and theoretical data was complemented by optic experimental data. Osteoblasts were then grown on the surface of the piezoelectric material and cell response studied.

Keywords: A. Smart material; Polymeric piezoelectric; C. Finite element analysis (FEA); C. Stress concentrations

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