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Piezoelectric scaffolds - on the way to effective cellular mechanotransduction

P.Ł. Sajkiewicz^{1*}, A. Zaszczyńska¹

Institute of Fundamental Technological Research Polish Academy of Sciences, Laboratory of Polymers and Biomaterials, Pawińskiego 5B, 02-106 Warsaw, Poland
**psajk@ippt.pan.pl*

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The discovery of electric fields in biological tissues has led to efforts in developing technologies utilizing electrical stimulation for therapeutic applications. Native tissues, such as cartilage and bone, containing collagens and glycosamineglycans (GAGs) exhibit piezoelectric behavior, with electrical activity generated due to mechanical deformation through physiological movement. However, the use of piezoelectric materials in tissue engineering has largely been unexplored.

The piezoelectricity of polyvinylidene fluoride PVDF is highly dependent on supermolecular structure which in turn is governed by conditions of material formation [1,2]. The relations between the conditions of formation, supermolecular structure and piezoelectricity of PVDF will be discussed. The nanofibrous structure of PVDF scaffolds is expected, mimicking part of extracellular matrix (ECM). Finally, our results of biological investigations in vitro using PVDF nanofibrous scaffolds under ultrasound stimulation together with the recent achievements reported in the literature will be shown.

In summary, we shown that using PVDF as piezoelectric polymer stimulated by ultrasounds is advantageous for cells activity. The obtained preliminary results are promising from the perspective of tissue engineering applications.

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References

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- [2] Kim YT et al. 2009, Biomaterials 2009;30 2582-25090.