to properties of natural articular cartilage (E_c=1.9-14.4 by 30% of strain [12]).

Conclusions

PVA hydrogels were prepared by combined chemical and physical process including chemical reaction between PVA and low molecular weight metabolite molecules, such as succinic and gluconic acid, respectively, followed by repeated freezing-thawing cycles. The highest compressive stress has been found for a blend containing 25% PVA and 3% gluconic acid after four cycles. After nine cycles, this blend showed still higher values as compared to the neat 25% PVA cryogel and PVA/PVP system (the last one was characterized by the highest crosslinking density). We demonstrated that usage of di- and monofunctional metabolites as crosslinking agents for PVA hydrogel in combination with repeated freezing-thawing process is an effective method for preparation of strong cryogels. Their mechanical properties compare very well with these of natural cartilage and can be considered for articular cartilage reconstruction.

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REPEATABILITY OF SOL-GEL BIOCOATINGS ON OPTICAL FIBERS EXAMINED BY STATISTICAL PATTERN RECOGNITION METHODOLOGY

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Introduction

The sol-gel production technology enables to obtain variously shaped materials from liquid precursors. The sol-gel coatings are the subject of many examinations, since they can find plethora of applications [1,2,3,4]. Coated subjects may gain new characteristics [5,6,7,8], like corrosion resistance [9], improved biocombatibility [10] or better electrical insulating properties [11]. Silica based sol-gel coatings may be used for production of fiberoptic applicators for laser therapies [12]. Interstitial laser thermotherapy is a quite new treatment of pathologic tissues in difficult to access environments (e.g. brain, liver), whereas the applicator is inserted into the pathologic lesion and curing laser light is guided through the fiber [13]. The other area of applications are bio- and chemosensors. This work presents the results of examination of sol-gel biocoatings surfaces.

Experimental

Materials

Sol-gel coatings were produced from solvents and reagents obtained from commercial sources and used without further purification: 96% ethyl alcohol (Merck), 98% tetraethylorthosilane (TEOS) (Fluka) and 37 % hydrochloride acid (Merck). The various coatings were prepared with R ratios equal 20, 32, and 40, where R denotes the number solvent moles to number of precursor moles. The HCl was added as the catalyst in proportion to ensure the acid hydrolysis (pH=2). The mixture was stirred for 4 hours by means of magnetic stirrer with the speed 400 rot/min at the room temperature. Optical fibers from Thorlabs (Hard Clad Silica, low OH) were used (core diameter ϕ_1=400 µm, HCS cladding ϕ_2=430 mm with external coating ϕ_3=730µm). First, the external jacket was mechanically removed on the distance of 2 cm. Next, the cladding was removed chemically by acetone and washed with ethyl alcohol. The sol-gel coatings were produced from freshly prepared hydrolyzates by dip-coating method, whereas the bar fiber tip was placed in liquid hydrolizate, which flow out form the container in the controlled manner (the outflow speed was calculated).

Procedures and methodology

All prepared fibers (20 for each ratio R) were dried for 24 hours in room temperature. After that, the microscopic pictures were taken by means of microscope (Nikkon optical microscope with PC interfaced digital camera) and stored in PC for further processing. The preprocessing was applied in order to obtain images compressed to 80x80 pixels bitmaps. The Linear Discriminant Analysis (LDA) for the feature selection and dimensionality reduction of data was exploited [14]. Then the classification based on Single Linkage method was performed. The picture in statistical pattern recognition methods is treated as a two-dimensional array of intensity values I(x,y). The recognition process was perform in order to find out the similarity between images. We divided the data base into 3 groups (corresponding to the types of applicators; one group for one R).

Results and discussion

The recognition procedure was applied to find out in which group the similarity score was the highest one. The higher the number of similar images, the higher is the repeatability of production process, thus the better quality of coatings. FIGURE 1 shows light distribution around the sol-gel coated applicator. The exemplary microscopic image of the coating surface is depicted by FIG.2.

The methodology called Face Recognition Vendor Test (FRVT) as used for assessment of face recognition technologies, was here applied for evaluation of the recognition system performance [15]. When an image is correctly recognized as belonging to the group with certain R factor, the performance measure for this case is the True Acceptance Rate (TAR). The second case is when the image is wrongly recognized as belonging to the certain R group (False Acceptance Rate - FAR). Next case is when the image from Rx group is wrongly classified as belonging to Ry (False Rejection Rate - FRR) and the last possibility - when the image is correctly rejected (True Rejection Rate - TRR).

In our work, the Equal Acceptance Rate (EAR) was a measure of system general performance (EAR is the rate at which the TAR is exactly equal to the TRR). The higher is EAR, the better is the recognition, meaning the higher number of similar coatings was detected. After statistical analysis we stated that the quality sol-gel biocoatings on optical fibers depends on the R ratio. The higher is R, the smaller number of images were recognized as belonging to the proper R group. It means that the differences between sol-gel coatings surface images were bigger. In our experiment we stated that for R=20, the EAR is 93%, for R=32 it is 89%, and for R=40, EAR is the lowest one and equals 83%.

Conclusions

The obtained results show that if the hydrolizate contains more solvent (Ethyl alcohol in our case), the drying procedure (even not forced) caused that the sol-gel coatings were not so homogenous (it was more difficult to achieve the repeatability of production process). We have demonstrated that it is possible to produce homogeneous sol-gel biocoatings with high repeatability, providing that the proper properties between solvents and precursor are ensured.

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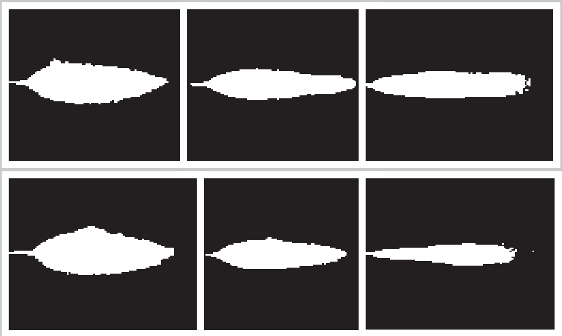

FIG. 1. The light distribution from sol-gel coated fibers (R= 20, 32, 40).

FIG. 2. The microscopic image of surface of sol-gel coated applicator tip. (R=32).

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PHYSIOLOGICAL ROLE OF BONE PIEZOELECTRICITY: RETROSPECT AND PROSPECT

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Introduction

It is about five decades now since Iwao Yasuda, a Japanese orthopaedic surgeon, reported a link between the physiology of bone growth and an electrical stimulus [1]. Eiichi Fukada and Iwao Yasuda [2] then related the empirical evidence of electrical potential to piezoelectric property in 1957, since a piezoelectric material, under stress, possess the ability to produce electric charge at its surface. Ideal examples of piezoelectric materials are quartz crystal and Pb-based ceramics. In the converse effect, a piezo-