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THE INVESTIGATION OF POROUS BIOMATERIALS THROUGH FRACTAL GEOMETRY METHODS

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Rezumat. *În ultimii ani, rezoluţia înaltă a microscopiei electronice şi analiza fractală s-au dovedit a fi un mijloc important pentru analiza structurii biomaterialelor. Scopul cercetării noastre este caracterizarea fractală a unor membrane de biopolimeri din colagen şi chitosan cu diferite rapoarte între componente. Pentru evaluarea imaginilor obţinute prin microscopie electronică de baleiaj am aplicat analiza fractală. Dimensiunile fractale au fost estimate prin metoda "numărării cuburilor" (box counting). Rezultatele obţinute indică faptul că membranele de biopolimer sunt fractali şi sunt caracterizate de dimensiuni fracţionare cu valori între 2 şi 3 (2 < D < 3).*

Abstract. *In recent years, high resolution electron microscopy and fractal analysis has proved to be an important tool for analysing the structure of biomaterials. The purpose of our research is the fractal characterization of biopolymer membranes with collagen and chitosan with different ratio between components. For the evaluation of the Scanning Electron Microscopy (SEM) images we applied fractal analysis. Fractal dimensions were estimated by the box counting technique. The results indicated that the biopolymer membranes are fractals and are characterized by non-integer dimensions with values between 2 and 3 (2 < D < 3).*

Keywords: Fractal dimension, Image analysis, Scanning Electron Microscopy (SEM), biomaterials

1. Introduction

New membranes based on collagen and chitosan biopolymers hydrogels doped with silver nanoparticles were fabricated and characterized to be used for medical applications. The new membranes were characterized by Scanning Electronic Microscopy (SEM) and fractal analysis. After Mandelbrot [1] a mathematical fractal is an object which has a very fragmented or irregular shape, presents self-similarity (or self-affinity), and presents scale-invariance. The familiar Euclidean dimension of the physical world is expressed as an integer such as "2" in 2-dimensional space for a flat surface or "3", for 3-dimensional space, geometrical solid object. We expect that for our collagen materials the fractal dimension D to be between 2 and 3. Based on fractal dimensional analysis, the morphological properties such as aggregate porosity or density can be correlated to fractal characteristics, which can be determined using image analysis. The value of the fractal dimension reflects the degree of irregularity of membrane pores. Different values of D show different types of membrane pores and perhaps their different formation mechanisms. The results obtained are useful for the investigation of the

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