Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 5, Issue 1, 2016

# Porous films (Scaffolds) for cell growing

Nino KEBADZE*
Tamar LOLADZE**

**Abstract**

We have obtained the biodegradable, bio-compatible scaffolds (base-film for cell growing) possessing well developed porous surface made of polyester amide 8-Phe-6 (poly-mer composed of sebacic, L phenylalanine and 1,6 – hexanediol). Porous films were ob-tained by ultrasonic or mechanical dispersion of two-phase system (water/biodegradable polyester amide solution in chloroform), followed by freezing of the obtained emulsion and subsequent freeze-drying.

**Keywords:** Bio-Compatible, Biodegradable Polymers, Scaffolds, Polyester Amide

## Introduction

Nowadays temporary scaffolds are in great demand in tissue engi-neering. Scaffolds are used for directing the migratory (wandering) tissue cell growth, or promoting the growth of the cells implanted in pores. For implementing these tasks the scaffolds are made of sub-strates promoting cell fixation (attachment), proliferation (growth) and differentiation. (Thomson, Shung, Yaszemski, Mikos, 2000; Hutmacher, 2000).

Biodegradable polymers have special place among the biomedical polymers; they are decomposed in the body and are designed to implement temporary function, such as surgical ma-terials (filaments, films, tubes, as well as construction materials), medical preparations, controlled/permanent release systems and others (Vert, 1989).

This type of polymers are hydrolyzed (biodegradation occurs) using enzymes of hydrolase class (trypsin, a- chimotripsin, lipase, and others) and the final products of biodegradation are involved in metabolic and ultimately, tissue regeneration processes. Such polymers have nutritional functions in addition to high bio-compati-bility (Katsarava, 1986; Törmäla, 1992).

The most common method for treatment of burns and open wounds is so-called closed method; for this type of treatment special porous wound coating materials are used. Coating materials protect wounds against bacterial invasion and external mechanical irritation. Exudate must not be accumulated under the cover because it acts as nutrient broth for bacteria.

Mostly, the coating materials are prepared from natural (for example, cotton fibers or gauze, as well as collagen films, etc.) or synthetic polymers. Preference is given to the latter because it virtually does not have immune reactions and has a wide range of properties.

Reference data show that the best matrix for developing wound dressing materials is synthetic biodegradable polymers; their positive traits are low immunogenicity and, unlike gauze, they do not stick to the wound and after tissue regeneration are spontaneously detached from it. In addition, biodegradable polymer allows manu-facturing of active drug-containing therapeutic (and not just protec-tive) wound covering materials with controlled drug release mech-anism (Katsarava, 1996). This material has an even increasing importance, if its biodegradation occurs by the erosive mechanism and controlled constant speed (Tsitlanadze, 2004).

Macrostructure, as well as the microstructure, determined by the chemical composition (primary structure) and supermolecu-lar (secondary) structure, has significant impact on the biological properties of the biodegradable polymers; in particular, the param-eters such as monolithic structure, porosity, degree of porosity, size and geometry of pores and size of the end product. These factors determine the interaction between the living tissue and polymeric implants.

It is known that the biomedical materials with developed porosi-ty - whether an inorganic material or polymer - significantly increase the biocompatibility of the material and promotes tissue healing.

The present study is dedicated to producing biodegradable, bio-compatible, porous polymer coatings with well-developed surface.

## Methodology

The porous films were prepared as follows: 0.5 g polyesteramide (8-Phe-6) was dissolved in 10 ml of chloroform and 5 ml of distilled

* Assoc. Prof. Dr., Department of Chemical and Biological Engineering, Georgian Technical University, Tbilisi, Georgia.
E-mail: n_kebadze@gtu.ge

** Assoc. Prof. Dr. Department of Metallurgy, Metals Science and Metal Processing, Georgian Technical University, & Faculty of Computer Technologies and Engineering, International Black Sea University, Tbilisi, Georgia.
E-mail: t.loladze@gtu.ge; tloladze@ibsu.edu.ge

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 5, Issue 1, 2016

water was added, dispersion was carried out using ultrasound or mechanical mixer. The duration of the dispersion was 0.5-1 min. The resulting emulsion was poured in Petri dishes and rapidly frozen at -180C. (To prevent water drops combination and phase separation. Under freezing water droplets pass into the solid state and after drying free space - pores are left in their place). At the first stage chloroform was removed by evaporation at atmospheric pressure, and then the water was lyophilized under vacuum.

## Results

Study of the ultrastructure of the films was carried out by the scanning electron microscope Cam Scan (Oxford), mode of the sec-ondary E-accelerating voltage was 20 kw. Samples were placed on a conductive substrate, placed on an aluminum stand and were gold-plated in a cathode ionic evaporator.

Both surfaces of the film (lower surface is adjacent to the glass surface and the top surface is in contact with the air) and their structure “in section” are investigated. The cross section of the films was deformed while cutting; it was caused by high elasticity and plastici-ty of the material. Consequently, for studying the structure the film was frozen in liquid nitrogen and then it was broken, providing the intactness of the internal structure.

Electron microscopic study of the films obtained by the above method has shown that their internal structure is characterized by the high porosity and almost does not depend on the water/ chloroform mixture dispersion method. This can be clearly seen on the microphotographs (Figure 1) where the pore size ranges between 10-30 microns, being optimal for mammalian tissue re-generation.

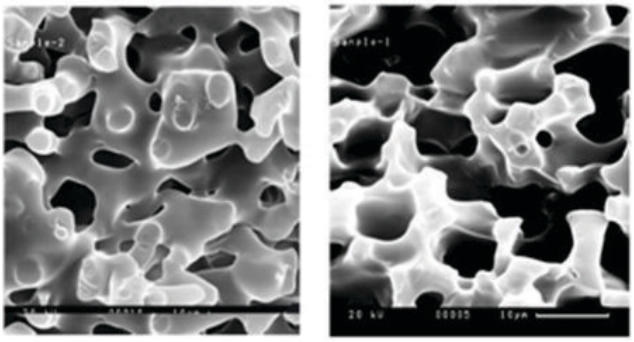

Figure 1. Scanning electronic microphotographs of polyesteramide (8-Phe-6) scaffold (“in section”) obtaind by:
a) ultrasonic dispersion;b) mechanical dispersion

## Conclusion

Biodegradable and bio-compatible scaffolds with well-developed porous surface have been obtained on the base of polyester amide 8-Phe-6. Porosity (pore size 10-30 microns) of the films was studied by electron microscopy. The pore size has a substantial effect on cell adhesion with scaffolds, and the porosity increases biocompatibility of the material; therefore, these kinds of scaffolds have a high potential in medical application for tissue regeneration..

## References

Thomson C.R., Shung A.K., Yaszemski M.J., Mikos A.G. 2000. Polymer scaffold processing. “Principles of Tissue Engineering”. Academic Press, San Diego., p. p. 251-265.

Hutmacher D. W. 2000. Scaffolds in tissue engineering bone and cartilage. Biomater., 21, 2529-2543.

Vert M. Degradation of polymeric biomaterials with respect to tem-porarytherapeutic applications: tricks and treats. 1989. First Intern. Scientific Consensus Workshop on Degradable Materials., Toronto, Canada, 2-4 Nov., p. p. 11-17.

Katsarava R. Some of the ways of synthesizing heterochain poly-mers based on naturally occurring amino acids. 1986. Polyamides, Polymer Composite Materials. (Kiev), 29, p. p. 70-77.

Törmäla P. 1992. Bioabsorbable Surgical Composite Materials. Adv. Mater., 4, 589- 592.

Katsarava R., Tsitlanadze G., Nadirashvili N., Dgebuadze Sh., Meiphariani A., Alavidze Z., Goderdzishvili M., Kvatadze N., 1996. Wound dressing “PhagoDerm”. Georgian patent # 1090.

Tsitlanadze G., Machaidze M., Kviria T., Djavakhishvili N., Chu C. C., Katsarava R. 2004. Biodegradation of amino acid based poly(ester amide)s: in vitro weight loss and preliminary in vivo studies. J. Biomater. Sci., Polym. Ed., 15 ,4 , 1-24.