THE EFFECT OF PLASMA TREATMENT ON SURFACE PHYSICOCHEMICAL PROPERTIES OF CHITOSAN/GLUCAN/HA BIOMATERIAL

AGATA PRZEKORA[1]*, JOANNA PAWŁAT[2]*, PIOTR TEREBUN[2], MICHAŁ KWIATKOWSKI[2], GRAŻYNA GINALSKA[1]

[1] CHAIR AND DEPARTMENT OF BIOCHEMISTRY AND BIOTECHNOLOGY, MEDICAL UNIVERSITY OF LUBLIN, POLAND
[2] INSTITUTE OF ELECTRICAL ENGINEERING AND ELECTROTECHNOLOGIES, LUBLIN UNIVERSITY OF TECHNOLOGY, POLAND
*E-MAIL: AGATA.PRZEKORA@UMLUB.PL, J.PAWLAT@POLLUB.PL

[ENGINEERING OF BIOMATERIALS 148 (2018) 9]

Introduction

Atmospheric pressure plasmas with their afterglow effect are often used for environmental and biological applications. Electromagnetic field, UV radiation, and share stress induced by the substrate gas flow can act on the sample in parallel to the chemical impact caused by reactive oxygen and nitrogen species generated in plasma. Thus, the synergetic effects of treatment can be expected. In surface processing, also in the case of biomaterials, which are not high temperature resistant, plasma is primarily used for surface cleaning, deposition, ablation or etching, surface activation and wettability control, crosslinking, and the formation of new functional groups [1-2]. The aim of this study was to evaluate the effect of plasma treatment on wettability and surface chemical composition of chitosan/β-1,3-glucan/HA biomaterial.

Materials and Methods

The chitosan/β-1,3-glucan/HA biomaterial was produced by mixing the liquid phase (the blend of 2.0 wt.% chitosan and 8.0 wt.% β-1,3-glucan) with 80 wt.% HA granules followed by thermal gelation for 20 min. at 90ºC and neutralization in NaOH solution [3]. Plasma was generated in a compact, AC powered glidearc reactor (GAD), which was operating at the atmospheric pressure and consisted of 2 diverging profiled cupper rod electrodes of 10 cm. The initial, smallest inter-electrode was settled as 3 mm [4]. Nitrogen was used as a substrate gas. Wettability as one of the important features describing the physicochemical surface properties of biomaterials was measured using Kruss DSA25E goniometer. Static and dynamic water contact angles (CA) were observed using static and dynamic sessile drop methods, respectively. ATR-FTIR analysis was performed to determine changes in surface chemical composition of the biomaterial.

Results and Discussion

After 16 s of GAD treatment, slight increase of hydrophobic properties was observed due to the initial behavior of polar groups present in the highly porous sample material. The observation of advancing water CA revealed slightly different surface behavior of plasma treated sample in comparison to the control: decrease to 20° after time and then its further penetration to the pores (FIG. 1 and FIG. 2). No significant changes in functional groups composition on the surface of the biomaterial was observed after 16 s of GAD treatment in nitrogen.

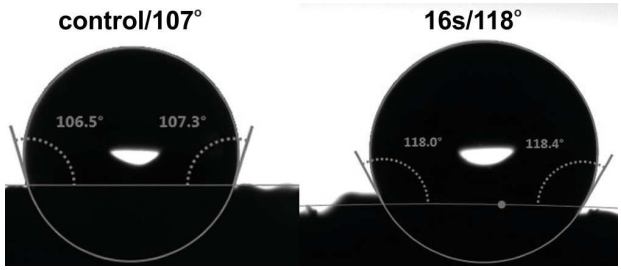

FIG. 1. Static sessile drop measurement of contact angle for GAD treatment.

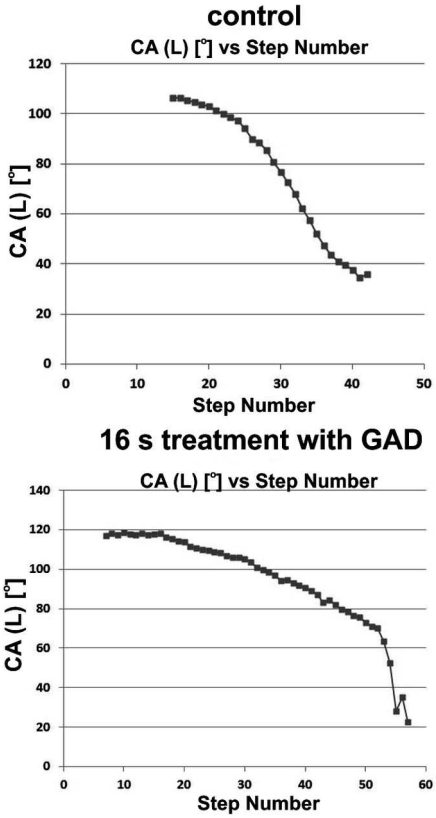

FIG. 2. Dynamic measurement of water contact angle for GAD treatment, substrate gas: nitrogen.

Conclusions

Obtained data demonstrated that plasma treatment of chitosan/glucan/HA biomaterial with the use of nitrogen as a substrate gas only slightly affects wettability and does not change surface chemical composition of the tested composite material.

Acknowledgments

Financial support was provided by NCN within M-Era.Net 2 research project no. 2016/22/Z/ST8/00694. The paper was developed using the equipment purchased within the agreement No. POPW.01.03.00-06-010/09-00 Operational Program Development of Eastern Poland 2007-2013, Priority Axis I, Modern Economy, Operations 1.3. Innovations Promotion.

References

[1] J. Pawłat, P. Terebun *et.al*., J. Phys. D. 37 (2016), 1-12.
[2] J. Pawłat, M. Kwiatkowski *et.al*., IEEE Trans. Plasma Sci. 44 (2015) 314-320.
[3] A. Przekora, K. Pałka *et al*., J. Biotech. 182 (2014) 46-53
[4] B. Dasan, B. Onal-Ulusoy, *et al*. Food & Bioprocess Technol. 79 (2016) 1-12.