# Chitosan/DPPC coated polymer surfaces activated by air plasma

Agnieszka Ewa Wiącek*, Małgorzata Jurak, Marta Worzakowska

*Department of Interfacial Phenomena, Maria Curie-Skłodowska University, Lublin, Poland*

** e-mail: a.wiacek@poczta.umcs.lublin.pl*

The development of biocompatible polymers and membranes has been a major subject of research in recent years. Biomimetic systems can be used in a variety of applications including molecular recognition, membrane fusion, implants and controlled drug delivery devices. Of particular interest for this work is chitosan which has several unique characteristics that are beneficial for biomedical applications, such as its biodegradable, biocompatible, nontoxic, and antibacterial properties. Another area of growing interest is the preparation of antimicrobial edible films and coatings [1]. Chitosan can be used as a hypocholesterolemic agent when added to the diet. In these applications, chitosan interacts in most cases with biomembrane surfaces. The bactericidal activity of chitosan is due to the electrostatic interactions between the $NH_3^+$ groups of chitosan and the phosphoryl groups of the phospholipid component of the cell membrane [2]. Accordingly, chitosan can interact with liposomes [3] and other mimetic systems, but few studies are reported on its interactions with the Langmuir and Langmuir-Blodgett/Schaefer films [4]. Strong interactions of chitosan with phospholipids may cause morphological changes and influence the membrane permeability.

In our studies the chitosan/phospholipid (DPPC) films on air plasma treated polyethylene terephthalate (PET) plates were prepared by two methods. One-step hybrid chitosan/DPPC coating was spreading of the chitosan solution onto the PET surface activated with air plasma. In the first method this stage was followed by spreading of the DPPC solution onto the previously dried chitosan film. In the second one a two-layered coating consisting of chitosan and DPPC was prepared by deposition of the phospholipid DPPC monolayer onto the PET/chitosan plate by means of the Langmuir-Blodgett/Schaefer techniques. The latter techniques offered the advantage of tightly packed phospholipid molecules. The wetting properties of the prepared layers were measured by determining the contact angles of water, formamide and diiodomethane. Moreover, the theoretical models were used to study the surface thermodynamics, i.e. surface free energy and its components.

It was found that the way of layers preparation had a significant effect on the wetting properties and surface free energy of the PET/chitosan/DPPC films. Both topographic features and surface chemistry influenced the surface hydrophilicity of materials. Polarity of the activated PET considerably decreased with the deposition of chitosan layer and then increased when the chitosan/DPPC film was present. Moreover, the study gives information on the film permeability strongly affected by the molecular packing. It is important to understand how chitosan interacts with cell membrane models and changes their organizations, because of great potential use of chitosan in several areas, including its application in cosmetics, biotechnology, medicine, and food preservation.

[1] M.Z. Elsabee and E.S. Abdou, *Mater. Sci. Eng. C*, 2013, **33**, 1819
[2] H. Liu, Y. Du, X. Wang and L. Sun, *Int. J. Food Microbiol.*, 2004, **95**, 147
[3] O. Mertins and R. Dimova, *Langmuir*, 2013, **29**, 14552
[4] F.J. Pavinatto,T.M. Nobre, L. Caseli, M.E.D. Zaniquelli, A. Pavinatto, H.S. Silva, D.S. dos Santos Jr., P.B. Miranda and O.N. de Oliveira Jr., *Langmuir*, 2007, **23**, 7666