THE CHALLENGES OF CREATING DEFORMABLE PLASMA COATINGS ON THE SURFACE OF ELASTIC POLYMERS

Ilya A. Morozov[1] Alexander S. Kamenetskikh[2] and Marina G. Scherban[3]

[1]*Institute of Continuous Media Mechanics UB RAS, Perm, Russia.*

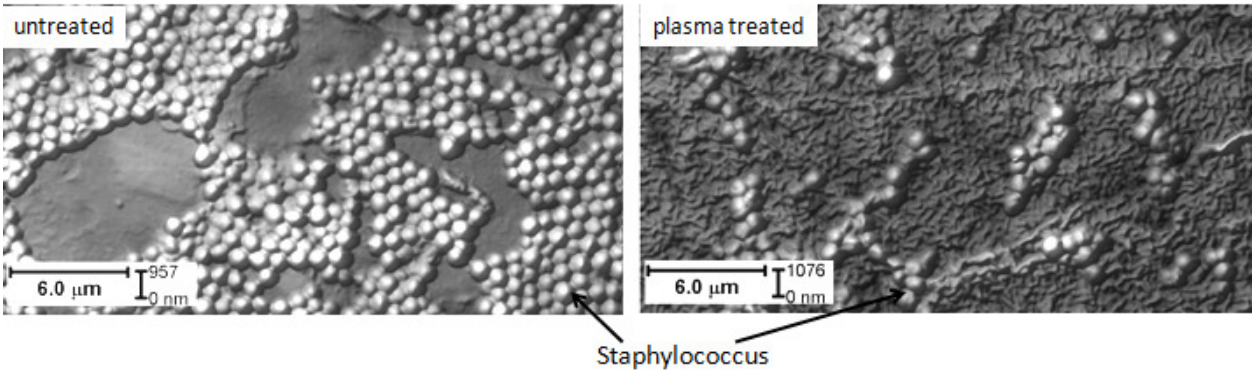
[2]*Institute of Electrophysics UB RAS, Ekaterinburg, Russia.*

[3]*Perm State University, Perm, Russia.*

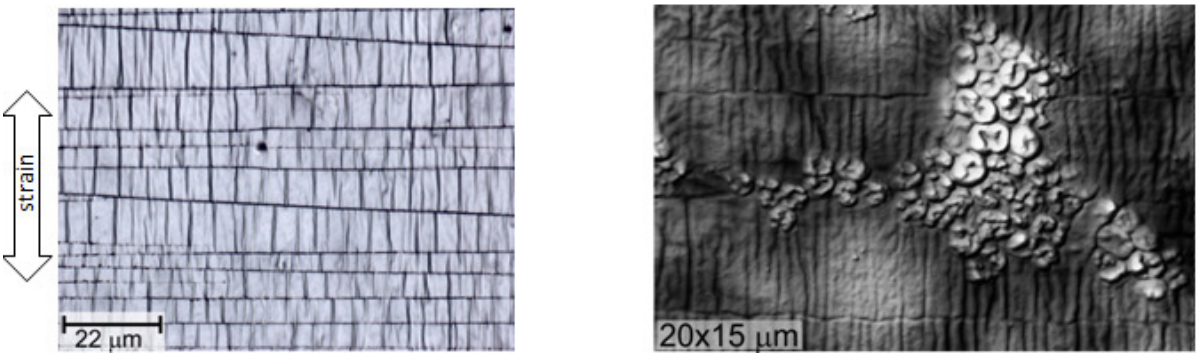
Abstract. Plasma treatment of polymers is a promising method of modifying surface properties. In particular, under the influence of gas plasma, the polymer structure is changed and a carbonized surface layer is formed, which affects the surface energy, relief texture and other surface properties. In this way, biomedical characteristics (sorption of proteins, decrease of bacterial adhesion) could be improved. However, external mechanical loads associated with the use of soft polymers can cause damage of the modified surface. In this work, the influence of low-energy plasma implantation of nitrogen ions (energies 0.1 and 0.5 keV) on the surface properties of elastic polyurethane is studied.

Thick (10 nm and more) plasma (energy 1 keV and more) coatings on elastic substrate.

Stiff coating wrinkles and reduces bacterial adhesion

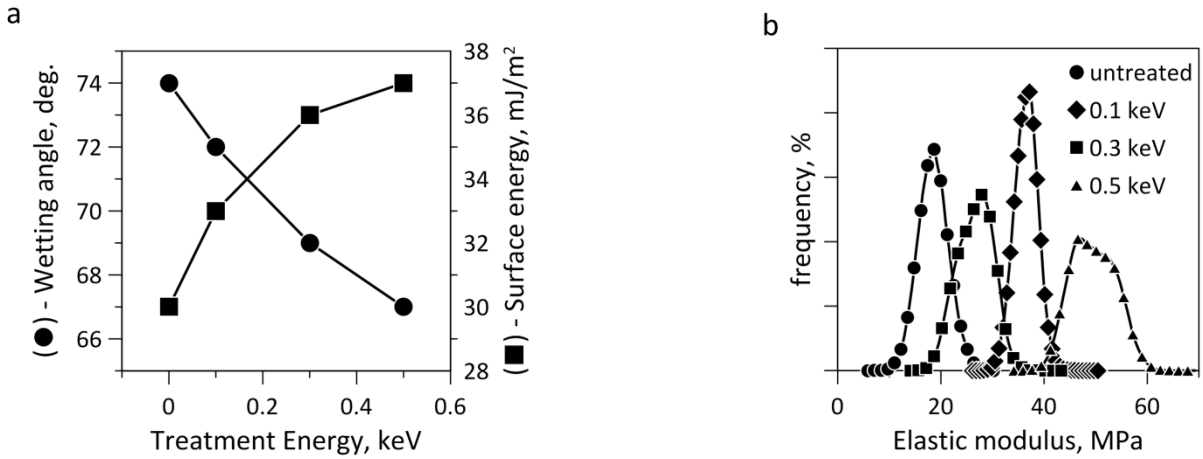


The problem! Such coatings damage under deformation. The defects are the new centers of the bacterial growth.



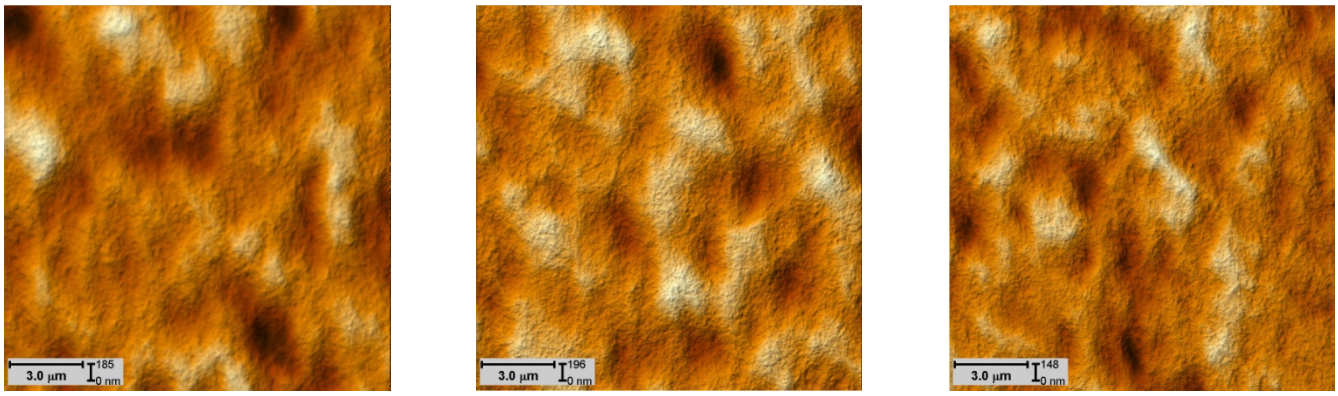
Solution: reduce treatment energy to low values: 0.1, 0.3 and 0.5 keV.

Treatment affected wettability, surface energy and elastic modulus of the surfaces.



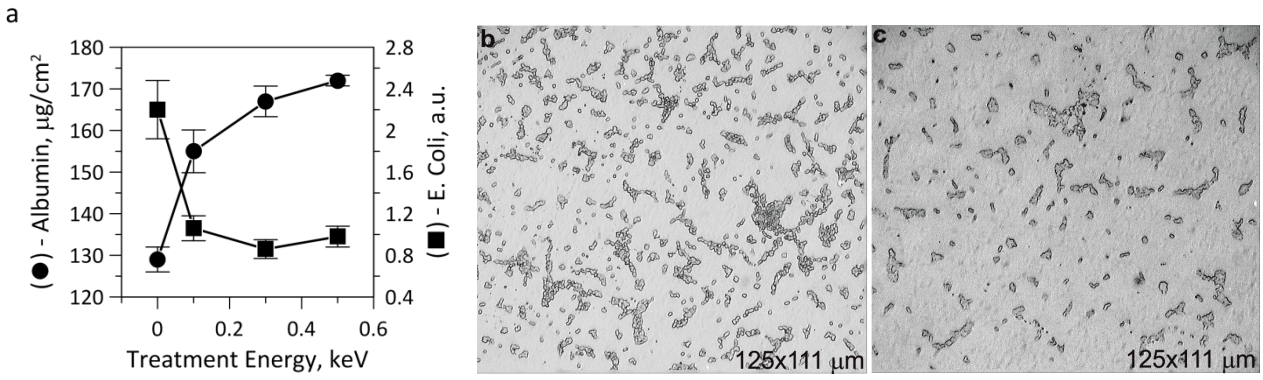
Wettability, surface energy (a) and elastic modulus (b) of the surfaces.

Relatively low elastic modulus of the coatings raises deformability of the coatings: no strain-induced damage observed during uniaxial mechanical tests.



Stretched to 50% treated (0.1, 0.3 and 0.5 keV) surfaces. Axis of deformation is vertical.

High surface energy and low wettability of the treated surfaces increases adsorption of albumin (human blood protein) and decreases bacteria e. coli.



Albumin and bacteria (e.coli) adsorption to the treated surfaces (a). Bacteria on untreated (a) and treated surface (b).

Resume. As a result of low-energy treatment the hydrophobicity and surface stiffness increase. In comparison with the higher plasma energy (1 keV and more), the damage of the stretched material surface does not occur. Changes in surface energy affects the protein and bacteria adsorption in better way.