

## THE INFLUENCE OF PLASMA TREATMENT ON ADHESIVE QUALITY OF SILVER NANOPARTICLES

B. CIGÁNOVÁ, K. ŠAFÁŘOVÁ, J. WIENER

*Technical university of Liberec, Studentská 2, Liberec 460 01*

*Centre for Nanomaterial Research, Palacký University, 17, Listopadu 50, Olomouc*

### Abstract

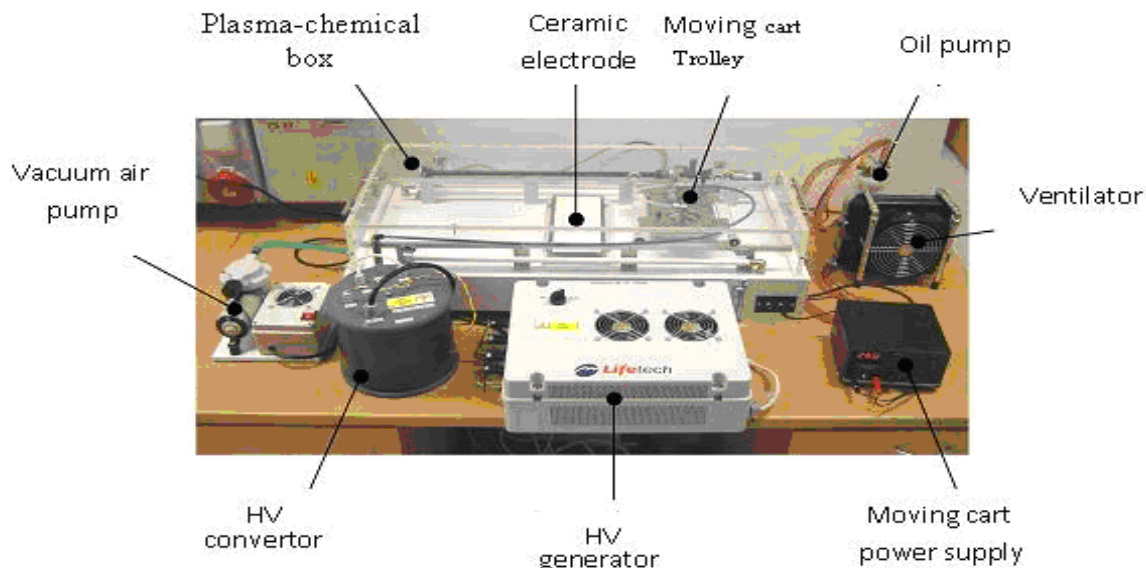
Textile materials have high porosity, high interior surface, along with high strength and structure flexibility therefore they are important from technical point of view. Textile materials are ideal carriers of nanoparticles whereas catalytic or barrier effect of these nanoparticles can be synergic advanced. The immobilization and fixation of this on textile surface are the main problems in application.

Plasma technology performed under atmospheric pressure is used to modify the chemical structure and also topography of the surface of the material. Fields of application can be: desizing, functionalizing, and design of surface properties of textile fibers.

Dielectric barrier discharge is broadly used for atmospheric pressure treatment of large movable materials. Surfaces of textile fibers can be modify with dielectric barrier discharge without modifying the bulk properties.

The influence of plasma treatment on sorption of silver nanoparticles from liquid on textile was tested in this study. The samples were treated by diffuse coplanar surface barrier plasma discharge (DCSBD). Changes in chemical structure were observed by FT-IR.

Nanoparticles were applied on surface from the solution. The antibacterial effect of silver was tested against *Escherichia coli*. The surface of fibres with nanoparticles was observed by scanning electron microscope (SEM).



**Fig.1** The photo of experimental device

### EXPERIMENT

Fibers were treated by means of the plasma source of Diffuse Coplanar Surface Barrier Discharge (DCSBD). Model of used equipment is DSCBD A4-LIN, which means that is device with linear displace working at atmospheric pressure. The power of generated discharge was 300 W and frequency 15 kHz (figure 1).

Before plasma treatment fibers were rinsed twice in isopropyl alcohol. Fibers were exposed to plasma ranging from 3 to 30 seconds. In this case the air was the operational gas.

Nanoparticles were applied on surface from the solution. The antibacterial effect of silver was tested against *Escherichia coli*.

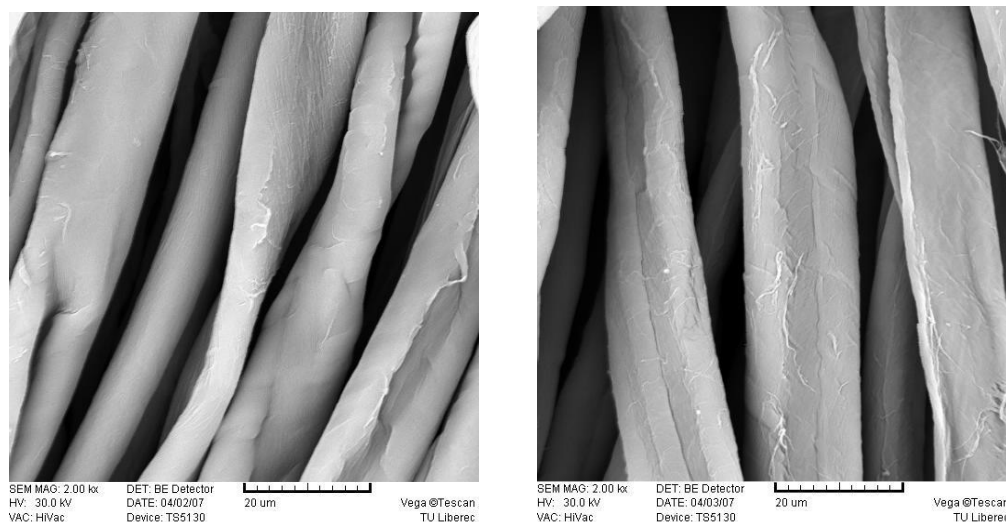
The structure and the appearance of fibres surfaces were observed with using of scanning electron microscope (SEM) on device VEGA. The alternative method to value fibre surface is infrared spectroscopy. For this analysis we used device FT-IR Spectrometer One by Perkin Elmer – ATR Technique on ZnSe crystals.

## RESULTS

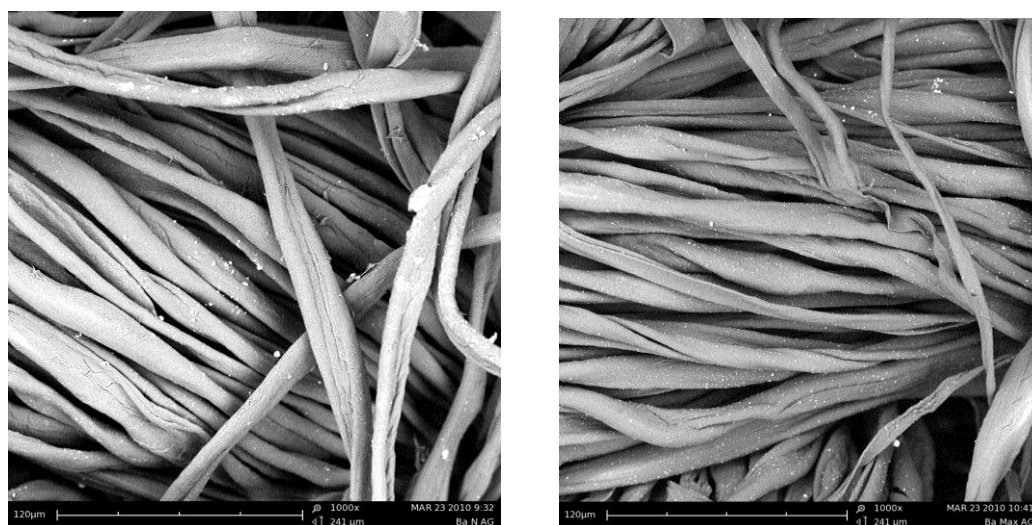
### SEM results

Morphological changes in the surface of the fibers after the application of plasmas in air are not visible. Influence of plasma no significant morphological changes in the fibers (figure 2).

Figure 3 shows the influence of plasma on the adhesion of silver nanoparticles on the fiber surface. The plasma modified fibers are trapped more particles of silver.



**Fig. 2** cotton a) plasma untreated and b) plasma treated 30s

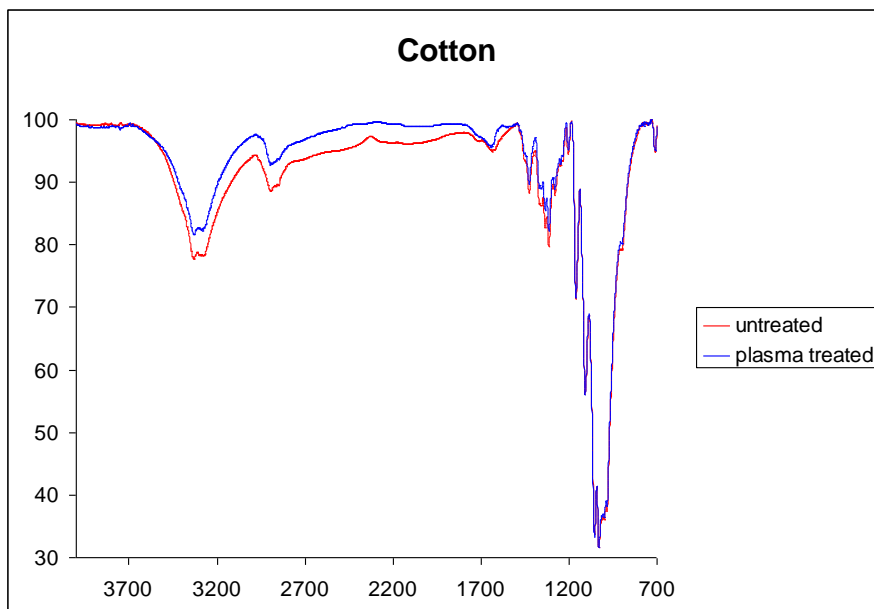


**Fig. 3** cotton with silver a) plasma untreated and b) plasma treated 30s

## FTIR results

Measurement was done by use of FTIR (PERKIN-ELMER). Primary objective of experiment was to describe changes of chemical bonds and formation of new chemical groups after the treatment.

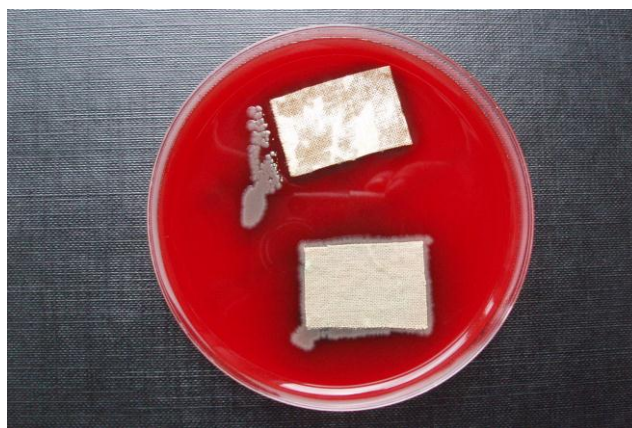
There were found no expressive changes of chemical structure in this case.



**Fig. 4** The influence source of plasma on chemical changes in the structure of cotton fabric

## The antibacterial effect results

The antibacterial effect of silver was tested against *Escherichia coli*. The figure 5 shows a sample containing the antibacterial effect of silver.



**Fig. 5** antibacterial effect a) plasma treated with silver and b) plasma untreated without silver.

## CONCLUSION

Plasma modification increased the amount of silver on the fiber surface. These particles mounted on the surface increased antibacterial activity against *Escherichia coli*. The results show a positive effect on the plasma increase the amount of silver nanoparticles and an increase in antibacterial effect.