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Interaction of low-temperature plasma with fabric: study by computer simulations

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This paper deals with the interaction of low-temperature plasma with fabrics. The paper is a continuation of the work that was presented during the last PSE conference two years ago. We presented a computer model of plasma–fabric interaction and the results obtained by accomplished calculations. These results were compared with layer profiles obtained experimentally. It was shown, that the layer was created on both sides of the textile material – on the side exposed to plasma source and on the reverse side. Furthermore we observed the penetration of active particles into the poruses and small chinks in textile – for example into places, where one thread crosses another one.
In this contribution we would like to aim on the influence of various plasma and material parameters on both the profile and the thickness of deposited layer. The main regard is given to the influence of working gas pressure in apparatus and parameters of the fabric on the deposited layer. The computer model of plasma–textile interaction is based on a rather simple fluid modelling technique. This is especially because of the complicated model geometry given by the surface of textile material, where the usage of these techniques seems to be still computationally inefficient. For example, in the part of the hybrid algorithm based on particle modelling technique, the interaction of active particles with the surface of fabrics needs to be considered. This surface is unfortunately described by complicated algebraic equations and the calculation is considerably time consuming. Nevertheless (according to the comparison of both theoretical and experimental data given in our previous work), it can be expected, that the presented model provides results with satisfactory precision.
The model geometry is based on the Pierce's model of threads in fabrics that was slightly modified for our purposes. The original Pierce's work considers that threads can be approximated as a union of cylinders and parts of torus having in the normal section an annular shape. In realistic fabrics this shape is rather elliptical, whereas this fact significantly affects the penetration of active particles into the material.

Keywords
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