 EFFECTS OF SURFACE MICROPATTERNING ON ENDOTHELIALIZATION OF AMORPHOUS HYDROGENATED CARBON (a-C:H) FILMS PRODUCED BY PLASMA IMMERSION ION IMPLANTATION AND DEPOSITION

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Amorphous carbon or diamond-like carbon (DLC) films have attracted much attention recently due to their good biocompatibility and have been proposed for use in blood contacting medical devices. The behavior of cultured cells is a good indicator of the surface biocompatibility and biological responses.

In this study, amorphous hydrogenated carbon films were produced and a series of micropatterning experiments were conducted on the surface of the DLC using sputtering and deposition by plasma immersion ion implantation and deposition with a mixture of argon and acetylene. The behavior of the endothelial cells was investigated. The micropatterning experiments were carried out using meshes of 100 m, 54 m, 26 m, and 12 m. A set of DLC films was sputter deposited using a radio frequency (RF) power of 500 W and a substrate DC bias voltage of -500 V. Another set of DLC films was deposited by plasma immersion ion implantation and deposition also with the meshes. The two DLC film properties were evaluated by Raman spectroscopy, X-ray photoelectron spectroscopy, and Fourier transform infrared spectroscopy. The surface topography was analyzed by surface profilometry and scanning electron microscopy.

Human umbilical vein endothelial cell (HUVEC) were seeded and cultured on the micropatterned surfaces for up to 7 days. The endothelial cell behavior was examined using optical microscopy and SEM after the cells were fixed and dehydrated. Our results reveal that surface micropatterning can help endothelialization and promote more extensive endothelialization compared to our control samples in the in vitro model.

1. P. Yang, N. Huang, Activation of platelets adhered on amorphous hydrogenated carbon (a-C:H) films synthesized by plasma immersion ion implantation-deposition (PIII-D), Biomaterials 24 (2003) 2821-2829
2. Julio C. Palmaz, Influence of Surface Topography on Endothelialization of Intravascular Metallic Material, April 1999 JVIR

PLASMA SURFACE MODIFICATION OF MEDICAL POLY VINYL CHLORIDE FOR IMPROVEMENT OF SURFACE ANTIBACTERIAL PROPERTIES

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There is an increasing interest on the development of antibacterial medical polymers in the biomedical industry. Most of antibacterial polymers are made by addition of antibacterial materials generally containing Ag+, but in inside humans, these antibacterial polymers may pose health hazards and so alternative polymeric materials must be developed.

In this work, plasma immersion ion implantation (PIII) is used to modify the surface of medical PVC (poly vinyl chloride) by DP-300 to improve its antibacterial performance. The surface is first activated by O2 plasma to produce more hydrophilic groups so that DP-300 can be coated well on the surface. Subsequently, Ar plasma-treatment is conducted under optimal conditions to rebder its surface antibacterial.

The modified surface is characterized by XPS, SEM, ATR-FTIR, AFM and contact angle measurements. The antibacterial performance is tested utilizing the method of plate counting of Micrococcus luteus (gram positive) and Escherichia coli (gram negative). The antibacterial performance with time and antibacterial mechanism of PVC are also discussed. Experimental results show that the plasma-treated surface exhibits good antibacterial performance while the favorable bulk properties of PVC are retained.

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