ABSTRACTS

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Fabrication of Ti-O / Ti-N Gradient Biomedical Films by Plasma Immersion Ion Implantation

Y. X. Leng [1,2], P. Yang [2], J. Y. Chen [2], X. B. Tian [1], L. P. Wang [1], Z. R. Zhou [2], N. Huang [1,2], and P. K. Chu [1*]

[1] *Department of Physics & Materials Science, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong, China*

[2] *Department of Materials Engineering, Southwest Jiaotong University, Chengdu 610031, China*

In the biomedical engineering research field, much attention has been paid to the surface modification of blood contacting materials. Ion implantation is quite attractive as a surface modification and thin film fabrication technique as almost all elements can be introduced and the impurity concentration does not suffer from thermodynamic constraints. However, conventional implantation processes such as ion beam enhanced deposition (IBED) are line-of-sight techniques and are only suitable for planar substrates. For the treatment of three-dimensional objects such as artificial heart valves, complicated sample manipulation is required thereby adding to the production cost and complexity. Plasma immersion ion implantation (PIII) circumvents the line-of-sight restriction inherent to beam-line ion implantation, eliminates complex focusing elements, and is potentially more economical. Being a non-line-of-sight process, large and complex-shaped objects can be implanted relatively easily. In this work, we investigate the synthesis and properties of Ti-O / Ti-N gradient films fabricated by PIII. As an artificial heart material, Ti-O improves the blood compatibility and Ti-N provides the required mechanical properties to withstand a high contact stress. The microstructure of the synthesized Ti-O / Ti-N gradient films is studied by x-ray diffraction (XRD). The chemical composition and elemental depth profiles of the films are measured by x-ray photoelectron spectroscopy (XPS). The blood compatibility is evaluated by clotting time measurement, thrombin time, prothrombin time test, and platelet adhesion investigation. Our results show that the Ti-O / Ti-N gradient films show blood compatibility much better than that of low temperature isotropic pyrolytic carbon (LTIC) which is currently the state-of-art materials for artificial heart valves. The mechanical properties of the Ti-O / Ti-N gradient films are assessed by measuring the microhardness and wear characteristics. Our data reveal that the films have better mechanical properties than LTIC. Hence, Ti-O/ Ti-N gradient films synthesized by PIII are potential more suitable than LTIC as an artificial heart valve material.

* *Corresponding author*
Prof. Paul K. Chu
Tel: (+852)-27887724: Fax: (+852)-27889549 or (+852)-27887830
Electronic mail: *paul.chu@cityu.edu.hk*