VI$^{th}$ International Workshop on Plasma-Based Ion Implantation

Abstracts

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Grenoble, France
June 26-28
Blood Compatibility and Hydrogen / sp² Contents of Diamond-Like Carbon (DLC) Synthesized by Plasma Immersion Ion Implantation - Deposition

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Diamond-like-carbon is an attractive material for blood contacting biomaterials such as artificial heart valves due to its high inertness and excellent mechanical properties. Using plasma immersion ion implantation - deposition (PIII-D), diamond-like carbon (DLC) films are fabricated on silicon substrates at room temperature. By changing the C₆H₆ to Ar (F₂/C₆H₆/F₂) flow ratios during deposition, the effects of the reactive gas pressure and flow ratio on the characteristics of the DLC films are systematically examined to correlate to the degree of blood compatibility. The composition, structure, sp³ content, carbon-hydrogen bonding, and hydrogen content are studied by Rutherford backscattering spectrometry (RBS), hydrogen forward scattering, Raman spectroscopy, low-energy electron energy loss spectroscopy (EELS), and Fourier transform infrared spectroscopy (FTIR). The blood compatibility of the films is evaluated in vitro platelet adhesion investigation. The adhesion, activation, and morphology of the platelets are investigated employing scanning electron microscopy (SEM). Our results show that the hydrogen and sp³ contents decrease with reduced reactive gas-flow ratios of C₆H₆ to Ar(F₂/C₆H₆/F₂), and the film has an amorphous diamond-like structure. We will describe the parameters needed for optimal deposition of good blood-compatible DLC films. Our study suggests that C₆H₆/Ar ratios can produce DLC films with good blood compatibility as well as proper sp³ and hydrogen contents.

Etching of SiO₂ and Si in an Inductively Coupled CF₄ Discharge Using a Pulsed DC Substrate Bias

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Etching of SiO₂ and Si was carried out in an inductively coupled CF₄ discharge. For the present experiments, the plasma coil ICP source was operated at a RF power of 300 W and pressure of 3 Pa. The substrate holder, cooled down to 0°C, was biased with a pulsed DC generator at a frequency of 150 kHz, a pulse voltage ranging from 0 to 500 V and a duty cycle of 80%. A transition from a fluorocarbon film growth on SiO₂ and Si to an etch regime is observed as the pulse voltage increases. The etch rate of SiO₂, measured by in situ ellipsometry and profilometry, is constant over the etching process and it is about 300 mm/min at a pulse voltage of 500 V. The selectivity of SiO₂ to Si is found to be about 5. After etching of Si and partial etching of SiO₂, the samples were studied in term of optical and structural properties using X-ray Photon Spectroscopy (XPS), Fourier Transform Infrared spectroscopy (FTIR), and Spectroscopic Ellipsometry (SE). Based on the XPS, FTIR and SE results, the structure of the etched surfaces can be established: a fluorocarbon film containing CF₄ and C₆F₄ (l = 1 to 3) is observed with a SiO₂/CF₄ interface for SiO₂ and a Si-CF₄ interface for Si. The fluorocarbon film on SiO₂ and Si is thinner as the pulse voltage increases, which is related to higher etch rate.