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Structure and Properties of Nitrogen-Doped Hydrogenated Amorphous Carbon Films Fabricated by Plasma Immersion Ion Implantation (PIII)


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Recently, carbon nitride films and amorphous carbon films have received much attention as potential biomaterials. Plasma immersion ion implantation-deposition (PIII-D) is a novel surface modification method in the biomaterials field. Its main advantages are high efficiency and non-line-of-site characteristic and it is readily adapted to biomedical devices with complex shape. In this work, nitrogen-doped hydrogenated amorphous carbon (a-C:H:N) films were deposited by PIII-D using N₂/H₂ gas mixtures. Deposition was carried out at a constant RF power of 500 W. By adjusting the mix of N₂/H₂, a series of a-C:H:N films with different nitrogen contents were obtained. The film chemistry was examined using micro-Raman, XPS and FTIR. The surface morphology of the films was characterized by atomic force microscopy (AFM). The wettability of the films was measured by contact angle measurements employing different well-known liquids. The corrosion resistance was evaluated using electrochemical analysis. The results show that the wettability and corrosion resistance of the films are enhanced with increasing nitrogen concentration in the films and higher nitrogen fraction in the gas that also affects the wettability of the film structure and chemical bonds cause by nitrogen doping. One of the important experimental observations is that incorporation of nitrogen into the sixfold carbon rings structure breaks the symmetry in the sp² domains.

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Efficient NOx Removal Using Silent Discharges and TiO2 Photocatalyst Simultaneously

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The emission of NOx from motor vehicles and so on has become a serious problem for the environment. The application of the combination of electric discharges and TiO2 as a photocatalyst for the purification of air has been intensively studied. When the UV light shorter than 380 nm is irradiated or Anatase type TiO2, a pair of an electron and hole is produced, which react with water or oxygen molecules and contribute to the radical production such as OH, then radicals accelerate the NO removal process. In N2 gas discharges, the light emission from the second positive band of N2 is quite strong and the light may excite TiO2 photocatalyst. It has been shown that NOx is effectively removed using the TiO2-filled packed bed discharge reactor with an H2O2 injector. Instead of using the packed bed reactor, in this study TiO2 photocatalyst is coated on the inner surface of a reactor by the sol-gel method to expand the passageway of the flow gas hoping to process the gas on a larger scale.

As the result, the NO removal rate by silent discharges was improved by 10–30% when using the TiO2 photocatalyst simultaneously. It has been achieved that the maximum NO removal efficiency is ~50 V/m equals to the removal rate ~60% and flow rate 1250ml/min. The dependence of the NOx removal on the TiO2 sintering temperature has also been investigated. It turns out that the sintering at 550 degrees Celsius is the most effective. The X-ray diffraction measurements suggest that the TiO2 at the temperature contains more Anatase type crystals.

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