OXIDATION OF SHORT CARBON FIBERS BY OXYGEN PLASMA

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INTRODUCTION

Oxidation of carbon fibers is a method commonly used to improve their adhesion to matrixes in the preparation of composite materials (1). The aim of this work is to evaluate the possibility and convenience of further increasing surface oxidation in short isotropic carbon fibers by the use of a cold oxygen plasma, not only in terms of the amount of oxygen introduced but also paying attention to the type of functionality achieved.

EXPERIMENTAL

Short, isotropic pitch carbon fibers, S-233 from Osaka Gas. Studied fibers include as supplied fibers plus two set of fibers submitted to oxygen plasma treatments of varying severity: 50W/1 min and 150 W / 5 min. All three sets of fibers (untreated and after oxygen plasma treatment) were characterized by C1s and O1s X-ray Photoelectron Spectroscopy (XPS, VG Scientific, Source : Al Mono Standard, CAE 20eV, Step 0.2 eV) (2) and by programmed pyrolytic degradation of oxygen complexes (TPD-MS).

RESULTS AND DISCUSSION

In Figure 1, XPS showed that the oxygen plasma treatment produces a strong surface oxidation. However, at higher power and longer time of exposure (150W/5min), the surface oxidative effect slightly declines. The same trend reversal due to a more drastic plasma treatment was already observed during oxidation of an activated carbon (3). Figure 2 shows a relative increase of the of –C=O and –C-O- region (<287 eV for C1s and < 533 eV for O1s) with increase of the treatment intensity.

TPD agrees with results obtained by XPS. CO_2 evolution showed a promotion of the acidic COO-functionality (carboxylic groups, anhydrides, lactones) in the fiber treated at 50 W / 1 min which recedes for the more severely treated fiber where basic surface groups become predominant.

CONCLUSIONS

XPS and TPD showed that oxygen plasma treatments increase the oxidation levels of short carbon fibers. This enrichment is compensated by a selective removal of the surface acidic groups on the most exposed surface. Different predominant functionalities can be achieved by varying the treatment conditions.

LITERATURE CITED

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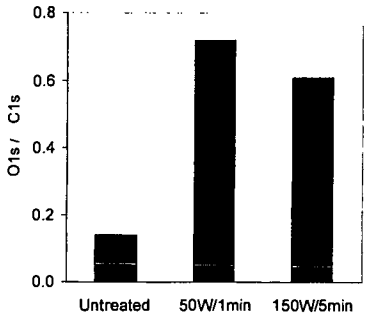

Figure 1. Effect of the plasma treatment on the XPS O1s / C1s ratio

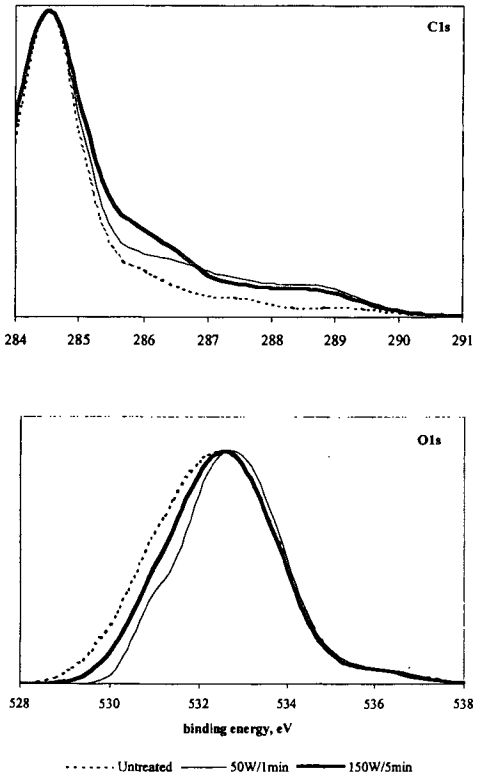

Figure 2 : Effect of the plasma treatment on the shape of the C1s and O1s spectra (normalized to the maximum of the untreated sample)