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Surface modification of PET film by plasma-based ion implantation

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Abstract

It has been reported that thin diamond like carbon (DLC) coating is very effective for enhancing the barrier characteristics of polyethylene terephthalate (PET) against CO_2 and O_2 gases. However, coating technique has a problem of DLC-deposit peeling. In this research, we develop a new technique to change the PET surface into DLC by ion implantation instead of coating the surface with the DLC deposit. The surface of PET film is modified by plasma-based ion implantation using pulse voltages of 10 kV in height and 5 μs in width. Attenuated total reflection FT-IR spectroscopy shows that the specific absorption peaks for PET decrease with dose, that is, the molecules of ethylene terephthalate are destroyed by ion bombardment. Then, laser Raman spectroscopy shows that thin DLC layer is formed in the PET surface area.

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Keywords: PET; Ion implantation; FT-IR; Raman; DLC; Plasma

1. Introduction

Polyethylene terephthalate (PET) is widely used as beverage containers and food or medicine packages due to the easy handling as well as the low cost. It is also suitable for recycling. However, the barrier characteristics against a certain kind of gases such as CO_2 and O_2 are not so good that the long-period maintenance of quality is hard for some beverages, beers, wines and medicines. The use of other polymer, polyethylene naphthalate (PEN) is effective to some extent for resolving the gas barrier problem [1]. But, the cost is higher and the material is not suitable for recycling. Recently, an European company developed a new technique that deposits thin diamond like carbon (DLC) on the inner surface of a PET bottle in order to enhance the gas barrier characteristics [2]. It has shown that thin-DLC deposit of 0.02–0.04 μm enhances the barrier characteristics more than ten times as large as the uncoated PET. However, as

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