STUDY OF THE FRACTURE OF COATING/SUBSTRATE SYSTEMS

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The depth sensing indentation test was used to study the mechanical properties of plasma deposited transparent $SiO_xC_yH_z$ coatings on polycarbonate (PC) substrates. The aim of the present work is to introduce the depth sensing indentation technique as a very sensitive tool for evaluation of the interfacial fracture toughness between the $SiO_xC_yH_z$ coating and the polycarbonate substrate treated in plasma by different ways. This method enabled to distinguish the effect of different plasma treatments and to find the optimum one.

Key words: *fracture toughness, thin films, plasma treatment, depth sensing indentation test*

1. Introduction

The depth sensing indentation (DSI) technique, which monitors the load and the indentation depth continuously, can be applied to measure various mechanical properties of thin films like hardness, elastic modulus and yield strength. If interfacial fracture of coating/substrate system occurs during DSI test, it is possible to evaluate the interfacial fracture energy or interfacial fracture toughness from the indentation results [1]. The interfacial fracture toughness K_{int} is the measure of the energy required to create a unit area of interfacial crack. If the film and/or the substrate is transparent, the area of the interfacial crack may be measured using optical microscopy.

The aim of the present paper is to study the interfacial fracture toughness of plasma deposited $SiO_xC_yH_z$ coatings on polycarbonate substrates. We focus in particular on the role of plasma treatment of polycarbonate (PC) surface in adhesion enhancement of $SiO_xC_yH_z$ coatings on PC substrates.

2. Experimental

The PC (LEXAN-LS2) substrates were treated in capacitive r.f. discharges (13.56 MHz) generated in parallel plate reactor, described elsewhere [2]. The treatment was performed using argon or oxygen at a pressure of 5 Pa. The applied power P ranged from 100 to 450 W and the negative bias voltage at the substrate holder bottom electrode ranged from -25 to -400 V.

$SiO_xC_yH_z$ films were deposited from hexamethyldisiloxane ($C_6H_{18}Si_2O$ – HMDSO) and oxygen mixtures ($P = 400$ W) 4 hours after plasma treatment. The HMDSO flow rate QHMDSO was 4 sccm, the oxygen flow rate Q_{O2} was 10 sccm. The composition of the films

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