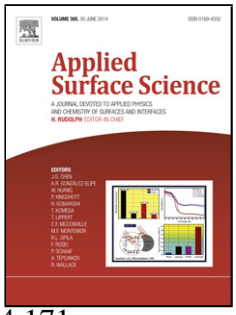

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Thin layer joining by gas adsorption

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Abstract

Attempt has been made to join borosilicate glass and cycloolefin(COP) polymer film by using gas adsorption method. After corona plasma treat, COP was exposed to (3-glycidoxypropyl) trimethoxysilane (GPS) and glass to (3-aminopropyl) triethoxysilane(APS) both in air atmosphere, resulting in co-adsorption of water vapor in the atmosphere and organosilane gases. Surface characterization of plasma treated and gas adsorbed surfaces was carried out by X-ray photoelectron spectroscopy (XPS) using $Mg_{k\alpha}$ X-ray source. Joining was carried out by a roll laminator after contact of both surfaces at room temperature, followed by annealing at 130 ℃ for 10 min. Adhesion strength was evaluated by 180 degree peel test based on ASTM D-903 and durability was examined under the conditions of 60 ℃ and 95 % RH.

It was found that after plasma treatment, complex functional groups such as C-H, C-O, C=O, O-C=O and CO3 were found on COP and O-H on glass.

Thickness of GPS gas adsorption layer on COP was evaluated by the XPS to be at least 1.1 nm by taking inelastic mean free path of Si_{2p} photoelectron into consideration. Joining force was found to be more than 5N/25 mm corresponding to almost equal to COP bulk tensile strength. In addition, durability of this adhesion strength remained unchanged over 2000 hours even after exposure to the durability test conditions of 60 ℃ and 95 % RH.

The results can be explained in terms of formation of H-H hydrogen bonding and Si-O covalent bonding via silanols will be made at the interface as a result of lamination and annealing processes.

In conclusion, ultrathin joining method by gas adsorption was established by the formation of hydrogen and covalent bonds at the interface by low temperature reaction process.