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Plasma Irradiation Technology for Direct Bonding of Various Plastic Films

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1. Introduction

Plastic films of biaxially oriented PET, polyimide and fluorocarbon polymers are used in various applications, utilizing their strong characteristics. Usually adhesives are used to laminate them, causing environmental issues. The backsheet of solar panels is composed of PVF/PET/PVF as shown in Fig.1 [1]. PET is mechanically strong and less-costly but not good for atmospheric tolerance, whereas PVF is excellent for atmospheric tolerance but costly. We developed the direct bonding of various films by plasma irradiation [2,3], then report here one of examples.

2. Experimental Procedures

The plasma irradiation apparatus is shown in Fig.2. The plastic film (PET, Toray Lumirror) is attached on the drum electrode, and the gas (O_2) is discharged to produce plasma to irradiate the film. The irradiated films are laminated by low heat press (140°C). The bonding strength is measured by 180°peel test. The non-irradiated, irradiated and laminated films are characterized by AFM, XPS, FTIR and GCMM [4].

3. Results and Conclusion

The XPS result is shown in Fig.3 for the non-irradiated and irradiated PET surfaces. The peak at 288.8 eV is attributed to O=C-O- constituting PET molecular structure.This is increased a little due to creation of COOH at the surface by the irradiation. The bottom at 287.6 eV is increased due to forming of C=O bond on the surface, and total oxygen content is increased by the irradiation. The results of GCMM and FTIR indicate that –OH and –COOH are increased on the PET surface by the irradiation. As shown in Fig.4, the irradiated PET are bonded tightly by the heat press at above 120°C, bonding strength is larger than 7 N/cm, beyond cohesion failure. All the results strongly suggest that the bonding is associated by the chemical bond due to "dehydrated condensation reaction" as well as the "hydrogen bond".

References

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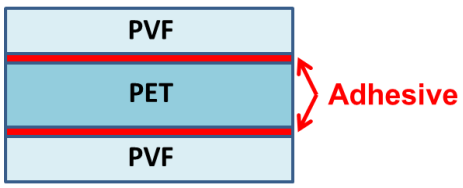

Fig 1.

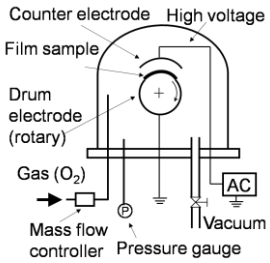

Fig 2.

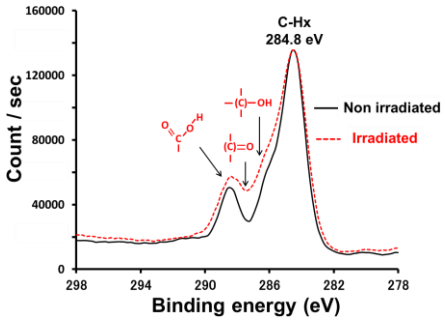

Fig 3.

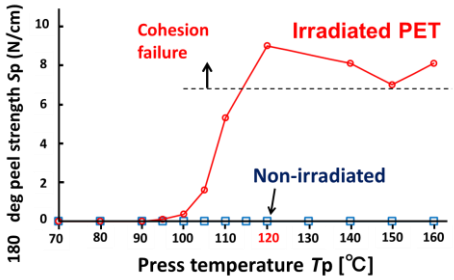

Fig 4.