

Analysis of the Surface and Interface Structures of Laminated Polymer Thin Films

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1.Introduction

Multilayered polymer films are industrially important because of their optimized properties. Ethylene vinyl alcohol copolymer (EVOH) has excellent barrier properties to gases and hydrocarbons. For example a laminate consisting of EVOH and polyethylene(PE) provides both gas and moisture barrier. Macroscopic physical properties of multilayered polymeric materials, such as adhesion and friction, relate to molecular aggregation structure at the surface and interface. The grazing incidence X-ray diffraction (GIXD) measurement is a superior tool for analysis of the surface and interface structures without any damage to the laminates. In this study, the surface and interface structures of EVOH-based laminates were investigated on the basis of the GIXD method.

2.Experimental Section

EVOH (General Science Co., Ltd.) 35 μ m films were prepared on the (110) plane of silicon substrates from a 3.0 wt% DMSO solution by a dip-coating method. Then styrene/maleic anhydride copolymer (StMAH) (General Science Co., Ltd.) and PE were coated on EVOH films by spin-coating and dip-coating methods, respectively. The

thickness StMAH and PE films were 0.04 μ m and 4 μ m, respectively. The obtained PE/EVOH and StMAH /EVOH laminates were annealed at $T_a = 433$ K, 453K and 473K for 10 minutes in vacuum. The in-plane GIXD measurement was carried out at the BL13XU beamline of SPring-8 using the incident X-rays with the wavelength λ of 0.1039 nm. The incident angle to the surface of a sample was 0.15 degrees.

3.Results and Discussion

The in-plane GIXD profiles were fitted using a Gauss-Lorentzian function on a linear background.

Figure1 shows annealing temperature dependences of the $d_{(110)}$ -spacing of EVOH. The $d_{(110)}$ of the PE/EVOH laminate annealed at $T_a = 473$ K was much larger than that at the

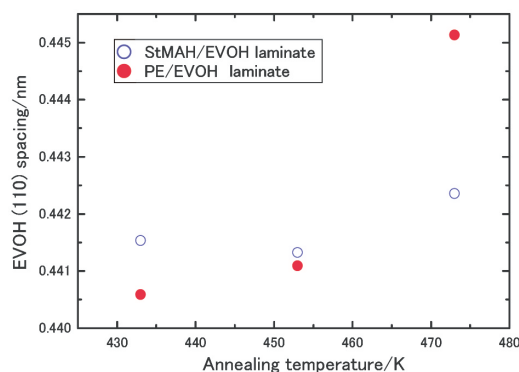


Figure1 Annealing temperature dependences of the $d_{(110)}$ -spacing of EVOH for the PE/EVOH and StMAH/EVOH laminates.

lower Ta . On the other hand, the StMAH/EVOH laminates show a little change in $d_{(110)}$ by annealing in this Ta range.

For the EVOH/PE and EVOH/StMAH laminates, we succeeded to clarify annealing effects on the interface structure from the molecular level by the in-plane GIXD measurements.

References

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