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Moisture Barrier Property and Mechanical Flexibility of Residual Stress Controlled SiOx Thin films Deposited by Pilot R2R-PECVD

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The technique of plasma enhanced chemical vapor deposition (PECVD) is increasingly being used in barrier film development on flexible substrates. Barrier films deposited on flexible substrates are essential for flexible device based on QD or OLED, OPV modules. PECVD technique brings a number of advantages including low temperature process, less damage to the flexible substrate and the possibility of high deposition rates.
In this study, a large area (over 500 mm width) of SiOx thin film was uniformly deposited on PET substrate using R2R-PECVD and SiH_4-NH_3 gas were used as precursors. We observed the residual stress change of the SiOx thin films with varying deposition process parameters and investigated the relationship between moisture barrier performance and mechanical flexibility according to the residual stress change.
In detail, the characteristics of residual stress, refractive index, radius of curvature, and water vapor transmission rate (WVTR) were investigated according to process power and reactive gas flow ratio. Under optimal process conditions, the moisture barrier performance of SiOx thin film on PET was reached down to $1.4 \times 10^{-3} g/m^2 \cdot day$ at 40□ and 90% relative humidity condition. In terms of mechanical flexibility, two-point bending tester results showed excellent radius of curvature of less than 2 mm in compressive mode. In addition, the fatigue test was carried out to confirm the reliability of the SiOx thin film. As a result, WVTR value can be kept below $4 \times 10^{-3} g/m^2$ $\cdot$day even after 10,000 cyclic bending test in the compressive mode.

Keywords
SiOx
R2R-PECVD
WVTR
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