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Optimizing The Organic/Inorganic Barrier Structure For Flexible Plastic Substrate Encapsulation

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Abstract

A multilayered barrier structure stacked with organosilicon and silicon oxide (SiO_x) films consecutively prepared using plasma-enhanced chemical vapor deposition (PECVD) was developed to encapsulate flexible plastic substrate. The evolution on the residual internal stress, structural quality of the organosilicon/SiO_x multilayered structure as well as its adhesion to the substrate were found to correlate closely with the thickness of the inset organosilicon layer. Due to the significant discrepancy in the thermal expansion coefficient between the substrate and SiO_x film, the thickness of the organosilicon layer deposited onto the substrate and SiO_x film thus was crucial to optimize the barrier property of the organosilicon/SiO_x structure. The organosilicon/SiO_x barrier structure possessed a lowest residual compressive stress and quality adhesion to the substrate was achieved from engineering the organosilicon layer thickness in the multilayered structure. The relaxation of the residual internal stress in the barrier structure led to a dense SiO_x film as a consequence of the enhancement in the Si-O-Si networks and thereby resulted in the reduction of the water vapor permeation. Accordingly, a water vapor transmission rate (WVTR) below 1×10^{-2} $g/m^2/day$ being potential for the application on the flexible optoelectronic device packaging was achievable from the 3-pairs organosilicon/SiO_x multilayered structure deposited onto the polyethylene terephthalate (PET) substrate.

Keywords: Multilayered barrier structure, organosilicon/SiO_x, plasma-enhanced chemical vapor deposition, flexible plastic substrate, residual internal stress, adhesion, water vapor transmission rate

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