Water vapor permeation properties of Al₂O₃/TiO₂ passivation layer on a poly (ether sulfon) substrate

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Organic electronic devices require a passivation layer to ensure sufficient lifetime. Specifically, flexible organic electronic devices need a barrier layer that transmits less than 10⁻⁶ g/m²/day of water and 10⁻⁵ g/m²/day of oxygen. To increase the lifetime of organic electronic device, therefore, it is indispensable to protect the organic materials from water and oxygen. Severe groups have reported on multi-layered barriers consisting inorganic thin films deposited by plasma enhanced chemical deposition (PECVD) or sputtering. However, it is difficult to control the formation of granular-type morphology and microscopic pinholes in PECVD and sputtering. On the contrary, atomic layer deposition (ALD) is free of pinhole, highly uniform, conformal films and show good step coverage. In this study, the passivation layer was deposited using single-process PEALD. The passivation layer, in our case, was a bilayer system consisting of Al₂O₃ films and a TiO₂ buffer layer on a poly (ether sulfon) (PES) substrate. Because the deposition temperature and plasma power have a significant effect on the properties of the passivation layer, the characteristics of the Al₂O₃ films were investigated in terms of density under different deposition temperatures and plasma powers. The effect of the TiO₂ buffer layer also was also addressed. In addition, the water vapor transmission rate (WVTR) and organic light-emitting diode (OLEDs) lifetime were measured after forming a bilayer composed of Al₂O₃/TiO₂ on a PES substrate.