Moisture-barrier property of nanolaminate-multilayer structures for thin-film encapsulation of flexible OLED lightings

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We present a hybrid organic-inorganic multilayer moisture barrier with a very low water vapor transmission rate less than 10^{-5}g/m^2/day. The inorganic layer is an optimized Al_2O_3/ZrO_2 nanolaminate and the organic layer is a plasma polymer synthesized with hexamethyldisiloxane monomer in a vacuum chamber. It has been known that the nanolaminates of Al_2O_3 and ZrO_2 show much higher moisture permeation resistance than the single oxide layers. we optimized the nanolaminate structure to have the lowest WVTR with the smallest thickness. For the organic layer, HMDSO-based plasma-polymer layers were synthesized on the inorganic nanolaminate surface with various thicknesses. The effect of the polymer thickness on the bending property of flexible OLEDs will be discussed. There are a number of advantages of the HMDSO plasma polymer, which are the high growth rate, the very low surface roughness, and the compatibility to the oxide nanolaminate. For the precise measurement of the WVTR, we have utilized the electrical Ca test. Ca test measurements have been carried out in the temperature of 85°C and the relative humidity of 85% for the accelerated tests.