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Thin Film Encapsulation with Organic-Inorganic Nano Laminate using Molecular Layer Deposition and Atomic Layer Deposition

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We fabricated an organic-inorganic nano laminated encapsulation layer using molecular layer deposition (MLD) combined with atomic layer deposition (ALD). The Al_2O_3 inorganic layers as an effective single encapsulation layer were deposited at 80 degree C using ALD with alternating surface-saturation reactions of TMA and H_2O . A self-assembled organic layers (SAOLs) were fabricated at the same temperature using MLD. MLD and ALD deposition process were performed in the same reaction chamber. The prepared SAOL- Al_2O_3 organic-inorganic nano laminate films exhibited good mechanical stability and excellent encapsulation property. The measurement of water vapor transmission rate (WVTR) was performed with Ca test. We controlled thickness-ratio of organic and inorganic layer, and specific ratio showed a lowest WVTR value. Also this encapsulation layer contained very few pin-holes or defects which were linked in whole area by defect test. To apply into real OLEDs panels, we controlled a film stress from tensile to compressive and flexibility defined as an elastic modulus with organic-inorganic ratio. It has shown that OLEDs panel encapsulated with nano laminate layer exhibits better properties than single layer encapsulated in acceleration conditions. These results indicate that the organic-inorganic nano laminate thin films have high potential for flexible display applications.

Keywords: ALD, MLD, Encapsulation, Al_2O_3