PT-P013

High Quality Nano Structured Single Gas Barrier Layer by Neutral Beam Assisted Sputtering (NBAS) Process

YunSung Jang, YouJong Lee, MunPyo Hong

Department of Display Semiconductor Physics, Korea University, Chungnam 339-700, Korea

Recently, the growing interest in organic microelectronic devices including OLEDs has led to an increasing amount of research into their many potential applications in the area of flexible electronic devices based on plastic substrates. However, these organic devices require a gas barrier coating to prevent the permeation of water and oxygen because organic materials are highly susceptible to water and oxygen. In particular, high efficiency OLEDs require an extremely low Water Vapor Transition Rate (WVTR) of 1×10^{-6} g/m^2/day. The Key factor in high quality inorganic gas barrier formation for achieving the very low WVTR required (1×10^{-6} g/m^2/day) is the suppression of defect sites and gas diffusion pathways between grain boundaries. In this study, we developed an Al_2O_3 nano-crystal structure single gas barrier layer using a Neutral Beam Assisted Sputtering (NBAS) process. The NBAS system is based on the conventional RF magnetron sputtering and neutral beam source. The neutral beam source consists of an electron cyclotron Resonance (ECR) plasma source and metal reflector. The Ar^+ ions in the ECR plasma are accelerated in the plasma sheath between the plasma and reflector, which are then neutralized by Auger neutralization. The neutral beam energies were possible to estimate indirectly through previous experiments and binary collision model. The accelerating potential is the sum of the plasma potential and reflector bias. In previous experiments, while adjusting the reflector bias, changes in the plasma density and the plasma potential were not observed. The neutral beam energy is controlled by the metal reflector bias. The NBAS process can continuously change crystalline structures from an amorphous phase to nano-crystal phase of various grain sizes within a single inorganic thin film. These NBAS process effects can lead to the formation of a nano-crystal structure barrier layer which effectively limits gas diffusion through the pathways between grain boundaries. Our results verify the nano-crystal structure of the NBAS processed Al_2O_3 single gas barrier layer through dielectric constant measurement, break down field measurement, and TEM analysis. Finally, the WVTR of Al_2O_3 nano-crystal structure single gas barrier layer was measured

to be under 5×10^{-6} g/m^2/day therefore we can confirm that NBAS processed Al_2O_3 nano-crystal structure single gas barrier layer is suitable for OLED application.

Keywords: WVTR, Gas Barrier, Passivation Layer, Al_2O_3, Organic Device