Structural, Electrical and Optical Properties of HfO_2 Films for Gate Dielectric Material of TTFTs

이원용, 김지홍, 노지형, 문병무, 구상모*
고려대학교 전자전기공학과, 광운대학교 전자재료공학과*

Wonyong Lee, Ji-Hong Kim, Ji-Hyoung Roh, Byung-Moo Moon, Sang-Mo Koo*
Korea University, Kwangwoon University*

Abstract : Hafnium oxide (HfO_2) attracted by one of the potential candidates for the replacement of si-based oxides. For applications of the high-k gate dielectric material, high thermodynamic stability and low interface-trap density are required. Furthermore, the amorphous film structure would be more effective to reduce the leakage current. To search the gate oxide materials, metal-insulator-metal (MIM) capacitors was fabricated by pulsed laser deposition (PLD) on indium tin oxide (ITO) coated glass with different oxygen pressures (30 and 50 mTorr) at room temperature, and they were deposited by Au/Ti metal as the top electrode patterned by conventional photolithography with an area of 3.14×10^{-4} cm^2. The results of XRD patterns indicate that all films have amorphous phase. Field emission scanning electron microscopy (FE-SEM) images show that the thickness of the HfO_2 films is typical 50 nm, and the grain size of the HfO_2 films increases as the oxygen pressure increases. The capacitance and leakage current of films were measured by a Agilent 4284A LCR meter and Keithley 4200 semiconductor parameter analyzer, respectively. Capacitance-voltage characteristics show that the capacitance at 1 MHz are 150 and 58 nF, and leakage current density of films indicate 7.8×10^{-4} and 1.6×10^{-3} A/cm^2 grown at 30 and 50 mTorr, respectively. The optical properties of the HfO_2 films were demonstrated by UV-VIS spectrophotometer (Scinco, S-3100) having the wavelength from 190 to 900 nm. Because films show high transmittance (around 85 %), they are suitable as transparent devices.

Key Words : HfO_2, TTFT, PLD, MIM capacitors