Fabrication and Characterization of MFIS-FET using Au/SBT/LZO/Si structure

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Abstract : Non-volatile memories using ferroelectric-gate field-effect transistors (Fe-FETs) with a metal/ferroelectric/semiconductor gate stack (MFS-FETs) make non-destructive read operation possible. In addition, they also have features such as high switching speed, non-volatility, radiation tolerance, and high density. However, the interface reaction between ferroelectric materials and Si substrates, i.e. generation of mobile ions and short retention, make it difficult to obtain a good ferroelectric/Si interface in an MFS-FET's gate. To overcome these difficulties, Fe-FETs with a metal/ferroelectric/insulator/semiconductor gate stack (MFIS-FETs) have been proposed, where insulator as a buffer layer is inserted between ferroelectric materials and Si substrates. We prepared $SrBi_2Ta_2O_9$ (SBT) film as a ferroelectric layer and $LaZrO_x$ (LZO) film as a buffer layer on p-type (100) silicon wafer for making the MFIS-FET devices. For definition of source and drain region, phosphosilicate glass (PSG) thin film was used as a doping source of phosphorus (P). Ultimately, the n-channel ferroelectric-gate FET using the SBT/LZO/Si Structure is fabricated. To examine the ferroelectric effect of the fabricated Fe-FETs, drain current (I_d) versus gate voltage (V_g) characteristics in logarithmic scale was measured. Also, drain current (I_d) versus drain voltage (V_d) characteristics of the fabricated SBT/LZO/Si MFIS-FETs was measured according to the gate voltage variation.

Key Words : MFIS-FET, SBT, LZO, ferroelectric