Exoploration of the hafnium oxide films grown by thermal oxidation

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ABSTRACT
In this thesis, hafnium was using thermal oxidation to the preparation of metal oxide for the rare earth element hafnium metal. Hafnium metal was deposited on silicon wafer by E-Gun and then proceeded with thermal oxidation in high temperature furnace tube for various oxidation temperature (600℃~900℃). The Capacitance-voltage (C-V) characteristic curve was measured by LCR Meter (1 MHz) high-frequency range and calculated for each sample of the oxide dielectric constant (ε) are greater than 25. By the instrument HP4156C measurements when the bias is -1V, the samples leakage current density are less than 10^{-7} A/cm² and the breakdown field strength are more than 9 MV/cm. The greater thickness of oxide film was obtained for the longer oxidation temperature by the transmission electron microscopy (TEM) measurement. The surface morphology of hafnium oxide films was measured by atomic force microscope (AFM). From the macro point of view, the grown oxide films of which thickness, surface roughness (Ra) vary with oxidation temperature. The crystal structure, showing tetrahedral shape into six-sided cone (Hexahedron) extent that octahedral pyramid (Octahedron), the nuclei of hafnium oxide started growing from the bottom (substrate surface) and gradually stacking up into a taper, there are similarities between the present pattern after rolling through the taper tip, the measure on surface of the oxidation films by Nanoscope III.
3.2 Experimental Planning

3.2.1 Silicon Dioxide (SiO2) Film Fabrication

3.2.2 Silicon Dioxide (SiO2) Film Electrical Characteristics

4.1 X-Ray Diffraction (XRD) Investigation of Oxide Cerium Structure

4.2 Transmission Electron Microscope (TEM) Investigation of Oxide Cerium Cross-Section

4.3 Oxide Cerium Film Surface Roughness (Surface Roughness) Measurement

4.4 X-Ray Photoelectron Spectroscopy (XPS) Measurement and Analysis

4.5 Oxide Cerium Film Binding Energy Step Analysis and Discussion

4.6 Oxide Cerium Capacitance-Voltage Characteristics

4.7 Oxide Cerium Current-Voltage Characteristics

5.1 Conclusion

5.2 Future Research Directions

REFERENCES


陳怡誠, 交通大學電子研究所碩士, 高介電薄膜簡介。

譚立威, 反應濺鍍氧化鈷與氧化鉬薄膜特性之研究。

孫允武, 半導體物理與元件 II場效電晶體原理, 中興物理。

孫允武, 應用電子學 IIIIIIIII的操作原理, 中興物理。

鄭正忠, 半導體製程技術導論 修訂版, 學銘圖書股份有限公司, 歐亞書局有限公司, 2006。

Hong Xiao, 譯者: 羅正忠, 半導體製程技術導論, 學銘圖書股份有限公司, 歐亞書局有限公司, 2006。


