# 鈦酸鍶鋇動態隨機讀取記憶體電極之研究


## 吳銈輝、洪瑞華

E-mail: 8809521@mail.dyu.edu.tw


**摘 要**


中文摘要 本論文主要以射頻磁控濺鍍法沉積金屬和導電氧化物( RuTi、IrO2 ) 之薄膜，探討其對於當做鈦酸鍶鋇電極之適用性。 我們利用不同金屬靶材釕和鈦，濺鍍沉積其合金。在沉積薄膜的過程中，主要以改變濺鍍功率所沉積得到的不同比例的釕-鈦合金，去探討不同成份合金熱處理前後膜的性質變化。發現在一定比例的釕-鈦合金，經過高溫製程以後仍然維持其一定的電阻率。而膜的表面平坦度在熱處理前後並無多大改變，也無剝落的情形，顯示其有良好的附著性。 其次，本論文同時探討以反應式射頻濺鍍沉積氧化銥薄膜的特性。我們藉由不同濺鍍氣體比例這一項沉基參數，討論氧化銥薄膜薄膜沉積的速度、電阻率、結晶特性、表面平坦度。然後再改變基板溫度，探討溫度對於氧化銥薄膜薄的電阻率和表面平坦度的影響。我們發現氩氣所佔比例較高的時候沉積速率較快，電阻率較低且膜的表面平整。相反的，當薄膜在低氩氣量的環境下沉積時，沉積速率變慢，電阻率升高且膜的表面粗糙。而基板溫度的改變則對於電阻率的降低有所影響，隨著基板溫度的增加，相對的電阻率降低。 最後將鈦酸鍶鋇沉積在薄膜上，經高溫處理後，量測其電特性，以評估其是否適合做為鈦酸鍶鋇之電極。



關鍵詞 : 下電極 ; 釕鈦合金 ; 氧化銥 ; 鈦酸鍶鋇


**目錄**


目錄 封面內頁 簽名頁 授權書.....................................................iii 簽署人須知................................................ iv 中文摘要.....................................................v 英文摘要....................................................vi 致謝..................................................... viii 目錄...................................................... ..ix 圖目錄........................................... .xii 表目錄..................................................... xv 第一章 緒論.......................................................1 1.1 動態隨機讀取記憶體(DRAM)發展現況......................1 1.2 高介電材料的種類....................................3 1.3 薄膜製作的技術.......................................4 1.4 電極的簡介與要求......................................5 第二章 實驗步驟與設備....................................8 2.1 基板的準備與清洗.....................................8 2.2 沉積系統設備.........................................8 2.3 熱處理裝置..........................................9 2.4 製程與參.............................................10 2.4.1 RuTi合金..........................................10 2.4.2 IrO2薄膜..........................................10 2.5 量測.................................................11 2.5.1 四點探針(Four point probe)..........................11 2.5.2 X-ray能量散佈分析儀(Energy Dispersive X-ray Spectrom-eter EDS).................................................... 11 2.5.3 原子力顯微鏡(Atomic Force Microscope；AFM)...........11 2.5.4 掃瞄式電子顯微鏡(Scanning Electron Microscope； SEM.................................................12 2.5.5 穿透式電子顯微鏡(Transmission ElectronMicroscope； TEM)..................................................12 2.5.6 二次離子質譜儀(Secondary Ion Mass Spectrometer；SIMS)...................................................12 2.5.7 橢圓偏光儀(Ellipsometer)...........................................13 2.5.8電流電壓量測(I-V)...................................13 2.5.9電容電壓量測(C-V)...................................13 第三章 結果與討論.........................................14 3.1 RuTi合金薄膜之特性....................................14 3.1.1 RuTi薄膜之電阻率...................................14 3.1.2 RuTi薄膜結晶晶體結構................................16 3.1.3 RuTi薄膜介面與表面分析..............................17 3.1.4 RuTi之氧化模型......................................18 3.2. IrO2薄膜之特性.......................................19 3.2.1 IrO2薄膜沉積與其電阻率..............................19 3.2.2 IrO2薄膜之表面態與結晶結構..........................21 3.3 沉積鈦酸鍶鋇於電極..................................24 第四章 結論...............................................26 參考文獻..................................................64


**參考文獻**


參考文獻 1. 電子資訊 87年3月刊。 2. 工業材料107期。 3. H, Yamaguchi, S. Matusubara, and Y. Miyasaka, ” Reactive Co-evaporation Synthesis and Characterization of SrTiO3 Thin Film ”, Jpn. J. Appl. Phys. ,30(9B),(1991)2197. 4.K. Iijima, T. Terashima, K. Hirata, and Y. Bando , ” Preparation of ferroelectric BaTiO3 Thin films by activated reactive evaporation ”, Appl. Phys. Lett., 56(6),(1990)527. 5.A. Mansingh and C.V. Kumar, ” Effect of the target on the structure and optical properties of radio-frequency sputtered barium titanate films ”, J. Mater. Sci. Lett. , 7,(1998)1104. 6.N.H.Cho, and H. G.kim, ” Characterization of SrTiO3Thin Films Prepared by RF Magnetron Sputtering ”, J. Phys. D : Appl. Phys., 25, (1992)727. 7.J.Gerblinger and H. Meixner , ” Electrical Conductivity of Sputtered Films of Strontitum Titanate “ ,J. Appl.Phys.,67(12),(1990)7453. 8.A. Nazeri, M. Kahn, T.Kidd, ” Strontium-Barium-Titanate Thin Films by Sol-Gel Processing ”,J.Mater.Sci.Lett.,14(1993)1085. 9.M. N. Kamalasanan, S. Chandra, P. C. Joshi, and A. Mansingh, ” Structure and Optical Properties of

Sol-Gel-Processed BaTiO3 Ferroelectric Thin Films ”, Appl.Phys.Lett.,59(27),(1991)3547. 10.M.Klee and P. K. Larsen, ” Ferroelectric Thin Films for Memory Applications:Sol-Gel Processing and Decomposition of Organo-Metallic Compounds “ ,Ferroelectrics,133,(1992)91. 11.P. C. Joshi and S. B. Kruparnidhi , ” Structural and Electrical Characteristics of SrTiO3 Thin Films for Dynamic Random Access Memory Applications ”,J.Appl.Phys.,73(11),(1993)7627. 12.P. C. V.Buskirk, R. Garadiner, P. S. Kirlin, S.Nutt, ” Reduces Pressure MOCVD of Highly Crystalline BaTiO3 Thin Films “ , J. Mater. Res.,7(3),1992(542). 13.L. A. Wills, B. W. Wessels, and T. J. Marks, ” Epitaxial Growth of BaTiO3 Thin Films by Organometallic Chemical Vapor Deposit-ion ”,Appl. Phys. Lett. ,60(1),(1992)41. 14.M. E. Pilleux and V. M. Fuenzalida, “ Hydrothermal BaTiO3 Films on Silicon:Morphological and Chemical Characterization ”,J. Appl. Phys. ,74(7),(1993)5897. 15.R. R. Bacsa ,J. P.Dougherty ,and L. J. Pilone, ” Low-Temperature Synthesis of BaTiO3 Thin Films on Silicon Substrate by Hydroth-ermal Reaction ”,Appl.Phys.Lett.,63(8),(1993)1053. 16.C. J. Peng, H. Hu, and S. B. Krupanidhi, ” Low-Energy Oxygen Ion Bombardment Effect on BaTiO3 Thin Films Grown by Multi-Ion-Beam Reactive Sputtering Technique ”, Appl. Phys. Lett. , 63(6), (1993)734. 17.S. Yamamichi, T. Sakuma, K.Takemura, and Y.Miyasaka, “ SrTiO3 Thin Film Preparation by Ion Beam Sputtering and Its Dielectric Prpoperties ”, Jpn. J. Appl. Phys., 30(9B), (1991)2193. 18.S. G. Yoon, J. C. Lee, and A. Safari, “ Preparation of Thin-Film (Ba0.5 ,Sr0.5)TiO3 by the Laser Ablation Technique and Electrical Properties ”, J. Appl. Phy. ,76(5),(1994)2999. 19.S. Wolf and R. N. Tauber, “ Silicon Processing for the VLSI Era ”, published by Lattice Press, CA Sunset Beach,(1986)384. 20.E. A. Kneer , D. P. Birnie, R. D. Schrimpf, J. C. Podlesny ,and G. Teowee, “ Investigation of Surface Roughness and Hillock Format-ion on Platinized Substrates Used for Pt/PZT/Pt Capacitor Fabrication ”,Integrated Ferroelectrics,7,(1995)61. 21.K. Sreenivas, I. Reaney, T. Maeder, and N, Setter , ” Investigation of Pt/Ti Bilayer Metallization on Silicon for Ferroelectric Thin Film Investigation ”,J.Appl.Phys.,75(1),(1994)232. 22. R. Bruchhaus, D.Pitzer, O.Eibl, U. Scheithauer, and W. Hoesler, ” Investigation of Pt Bottom Electrode for insitu Deposited pb(Zr,Ti) 3(PZT) Thin Film ”,Mater.Res.Soc. Symp. Proc.,243(1992) 93. 23.K.Sreenivas, M. Sayer, T. Laursen , J. L. Whitton, R. Pascual, D. J. Johnson, D. T. Amw, G. I. Sproule, and K. xorn, ” Characterization of Lead Zirconate Titanate (PZT)-Indium Tin Oxide (ITO) Thin Film Interface “ , Mater. Res. Soc. Symp. Proc., 200,(1990)255. 24.D. P. Vijay and S. D. Desu, “ Electrodes for PbZrxTi1-xO3 Ferroele-ctric Films ”, J. Electrochem. Soc., 140(9),(1993)2640. 25.L. A. Bursill, I. M. Reaney, D. P. Vijay, and S. B. Desu , ” Comparison of Lead Zirconate Titanante on Ruthenium Oxide and Platinum Electrodes ”, J. Appl.Phys.,75(3),(1994)1521. 26.H. N. Al-Shareef, A. I. Kingon, X. Chen, and K. R. Bellur , ” Contribun of Electrodes and Microstructures to the Electrical Properties of Pb(Zr0.53Ti0.47)O3 Thin Film Capacitors:, J. Mater. Res., 9(11),(1994)2968. 27. A. Grill, W.Kane, J. Viggiano, M. Brady, and R. W. Tustison, ” Base Electrode for High Dielectric Constant Oxide Materials in Silicon Technology ”, J.Mater. Res,7(12),(1992)3260. 28. S. Yamamichi, P. Y. Lesaicherre, H. Yamaguchi, K. Takemura, S. Sone, H. Yabuta, K. Kato T. Tamura, K. Nakajima, S. Ohnishi, and H. Ono, “ An ECR MOCVD (Ba,Sr)TiO3 Based Stacked Capacitor Technology with RuO2/Ru/TiN/TiSix Storage Nodes for Gbit-Scale DRAm ”,IEDM-95,(1995)119. 29.Lawrence H. Van Vlack/著, 李志偉、劉森源/譯, 材料科學與工程, 6th , page 3689. 30.劉國雄、林樹均、李勝隆、鄭晃忠、葉均蔚, 工程材料科學,page 886.