TFT元件之模擬與分析

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摘 要

近來，複晶矽薄膜電晶體(POLY-SI TFT)在應用於ULSI高密度靜態隨機存取記憶體的負載電阻和大面積主動矩陣式液晶顯示器(AM-LCD)之驅動電路方面深具潛力，故而廣受矚目。在本論文中，我們針對上電極複晶矽薄膜電晶體之製程效應及元件結構加以探討。我們研究了閘極絕緣包覆輕參雜汲極製程(GO-LDD)對於複晶矽薄膜電晶體特性所產生的影響，同時也研究了SI1-XGEX化合物薄膜電晶體的特性，探討其低溫製程的優點，對於應用在顯示器驅動電路開關元件上的可行性。 首先，我們探討了電晶體結構對於其所表現出電特性的關係，實驗結果顯示採用閘極絕緣包覆輕摻雜製程，對於當開關元件使用的薄膜電晶體，在漏電流方面有改善的效果，同時亦增加了元件的開關電流比。此外，新的製程方法也減少了傳統的製程步驟。 其次，我們採用其他材料取代以往的複晶矽薄膜，模擬其元件特性，藉由其低溫成膜優點，探討其他材料替代傳統高溫製程複晶矽薄膜電晶體的可行性。

關鍵詞 : 複晶矽, 非晶矽, 輕摻雜製程

目錄

參考文獻

[1]陳連春編譯，「彩色液晶顯示器原理與技術」;建興出版社.

[2]VLADIMIR G. CHIGRINOV，" LIQUID CRYSTAL DEVICES:PHYSICS AND APPLICATIONS"; ARTECH HOU -SE, P.241, 1999.

[3]MICHAEL SHUR，" INTRODUCTION TO ELECTRONIC DEVICES " ; JOHN WILEY & SONS INC, 1995.

[4]TOSHIHISA TSUKADA，"TFT/LCD LIQUID-CRYSTAL DISPLAYS ADDRESSED BY THIN-FILM TRANSISTORS "; GORDON AND BREACH PUBLISHERS, P.60, 1996.

[5]CARLSON, D.E. AND WRONSKI, C.R. (1976). "AMORPHOUS SILICON SOLAR CELL"; APPLIED PHYSIC -S LETTERS, 28, 671-673.

[6]SHIMIZU, I., KOMATSU, T., SAITO, K., AND INOUE, E. (1980). "A-SI THIN FILM AS A PHOTO- RECEPTOR FOR ELECTROPHOTOGRAPHY"; JOURNAL OF NON-CRYSTALLINE SOLIDS, 35&36, 773-778.

[7]KANEKO, Y., SASANO, A., TSUKADA, T., ORITSUKI, R., AND SUZUKI, K. (1986) "IMPROVED REL -IABILITY IN AMORPHOUS SILICON THIN-FILM TRANSISTORS" EXTENDED ABSTRACTS OF THE 18TH INTERNATIONAL CONFERENCE ON SOLID STATE DEVICES AND MATERIALS (TOKYO 1986). PP. 669- 702. TOKYO: THE JAPAN SOCIETY OF APPLIED

PHYSICS.
[8]POWELL, M.J. (1983). "CHARGE TRAPPING INSTABILITIES IN AMORPHOUS SILICON-SILICON NITR -IDE THIN-FILM TRANSISTORS"; APPLIED PHYSICS LETTERS, 43, 597-599.
[9]T. Y. HUANG, L. W. WU, A. G. LEWIS, A. CHIANG, AND R. H. BRUCE, "A SIMPLER 100-V POLYS -ILICON TFT WITH IMPROVED TURN-ON CHARACTERISTICS"; IEEE ELECTRON DEVICE LETT,, VOL.
[1], NO.6, PP. 244-246, 1990.
[10]M. C. OZTURK, Y, ZHONG, D, T, GRIDER, M. SANGANERIA, J. J. WORTMAN, AND M. A. LITTLEJO -HN, "SELECTIVE DEPOSITION OF POLYCRYSTALLINE SI1-XGEX BY RAPID THERMAL PROCESSING"; IN PROC. SPIE - THE INT. SOCIETY FOR OPTICAL ENGINEERING, PP. 260-269, 1990.
[11]陳熊光, 陸一民, 王文通; "低溫複晶矽薄膜電晶體液晶顯示器技術"; 光訊 68, PP.26, 2000/10.
[12]JAMES B. KUO, "COMS DIGITAL IC"; MCGRAW-HILL INTERNATIONAL EDITIONS, 1996,8.
[13]VIVEK SUBRAMANIAN, KRISHNA C. SARASWAT, "OPTIMIZATION OF SILICON-GERMANIUM TFT'S THRO -UGH THE CONTROL OF AMORPHOUS PRECURSOR CHARACTERISTICS"; IEEE TRANSACTIONS ON ELECTR -ONIC EVICES, VOL. 45, NO. 8, PP. 1690-1695, 1998.
[14]TOR A. FJELDY，TROND YTTERDAL，AND MICHAEL SHUR"INTRODUCTION TO DEVICE MODELING AND CIRCUIT SIMULATION "1998，JOHN WILEY & SONS INC.
[15]R.L WEISFIELD , H. C. TUAN , L. FENNELL , AND M. J. THOMPSON ," AMORPHOUS SILICON THIN FILMS TRANSISTORS ARRAY TECHNOLOGY :APPLICATION IN PRINTING AND DOCUMENT SCANNING " , MASTER. RES. SOC. SYMP. PROC. , VOL.95, PP.469-474 , 1987 .
[16]M.J THOMPSON AAND H. C. TUAN , "AMORPHOUS SILICON ELECTRONIC DEVICES AND THEIR APPLIC ATIONS" , IN IEDM TECH. DIG. , PP192-195 , DEC. 1986.
[17]H.AOKI AND E. KIGOSHI, "A NEW SEMI-EMPIRICAL MODEL FOR AMORPHOUS SILICON THIN-FILM-TRA -NSISTORS ," IN PROC. 1993 INT. VPAD, PP. 138-139 [18]N. IBARAKI, M. KIGOSHI , K. FUKUDA AND J. KOBAYASHI , "THRESHOLD VOLTAGE INSTABILITY OF A-SI:H TFT'S IN LIQUID CRYSTAL DISPLAYS , " J. NON-CRYSTALLINE SOLIDS , VOL. 115, PP. 138-140, 1989.
[19]A.VLADIMIRESCU AND S. LIU , "THE SIMULATION OF MOS INTEGRATED CIRCUITS USING SPICE2 , " UCB/ERL M80/7 , 1980.
[20]M. S. SHUR, H. C. SLADE, T. YTTERDAL, L. WANG, Z. XU, K. AFLATOONI, Y. BYUN, Y. CHEN, M. FROGGATT, A. KRISHNAN, P. MEI, H. MEILING, B.-H. MIN, A. NATHAN, S. SHERMAN, M. STE -WART, AND S. THEISS, MODELING AND SCALING OF A-SI:H AND POLY-SI THIN FILM TRANSISTORS , MAT. RES. SOC. SYMP. PROC., VOL. 467, PP. 831-842 (1997)
[21]M. S. SHUR, H. C. SLADE, M. D. JACUNSKI, A. A. OWUSU, AND T. YTTERDAL, SPICE MODELS FOR AMORPHOUS SILICON AND POLYSILICON THIN FILM TRANSISTORS, J. ELECTROCHEM. SOC., VOL . 144, NO. 8, PP. 2833-2839, (1997).
[22]H.C. SLADE AND M. S. SHUR, ANALYSIS OF BIAS STRESS ON THE PERFORMANCE OF UNPASSIVATED HYDROGENATED AMORPHOUS SILICON THIN FILM TRANSISTORS, IEEE TRANS. ELECTRON DEVICES, AC -CEPTED FOR PUBLICATION.
[23]M.S. SHUR, H.C. SLADE, T. YTTERDAL, L. WANG, AND Z. XU, "MODELING AND SCALING OF A-SI: H AND POLYSILICON THIN FILM TRANSISTORS," INVITED PAPER TO BE PRESENTED AT THE MATERI -ALS RESEARCH SOCIETY SPRING 1997 MEETING, AMORPHOUS AND MICROCRYSTALLINE SILICON TEC -HNOLOGY, APRIL 1997.
[24]H. C. SLADE, M. S. SHUR, S. C. DEANE, AND M. HACK, "BELOW THRESHOLD CONDUCTION IN A-SI :H TFTS WITH AND WITHOUT A SILICON NITRIDE PASSIVATING LAYER," APPLIED PHYSICS LETTER S, VOL. 69, NO. 17, P. 2560 (OCTOBER 1996).
[25]A. OWUSU, M. D. JACUNSKI, M. S. SHUR, AND T. YTTERDAL, SPICE MODEL FOR THE KINK EFFECT IN POLYSILICON TFTS, P. 680, IN MEETING ABSTRACTS, VOL. 96-2, FALL MEETING, SAN ANTON IO, TEXAS, THE ELECTROCHEMICAL SOCIETY, NEW JERSEY, ISBN 0160-4619, OCTOBER 6-11, 1996.