# 交流電源參數對鋁板電解粗化行為之影響


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**摘 要**

本研究針對平版印刷用1050中鋁鋁底材進行電解粗化製程，藉由蝕孔形貌與微結構觀察以及表面性質 分析，來瞭解粗化時蝕孔衍生成長機構與與腐蝕膜的生成機制。以交流電源進行電解粗化主要探討的變 因包括頻率、波形、正負半週期電量與電流密度峰值等。粗化後鋁板其中一個試片浸漬於鉻酸、磷酸混 合液中去除腐蝕膜，藉由量測表面粗糙度、鋁溶蝕量、蝕孔衍生數目與靜電容量進行表面性質分析，並 利用SEM觀察蝕孔形貌，另一個試片直接以SEM觀察蝕孔形貌以及橫截面TEM解析蝕孔形貌與腐蝕膜組織 結構，並以EDS半定量分析腐蝕膜之組成。 實驗結果顯示，在低頻(1HZ)時，所得蝕孔較粗大，50HZ左右為均勻粗化且蝕孔細小，當高頻(≧250 HZ)時則轉變成條狀蝕孔且粗化不均勻，又頻率增加腐蝕膜的層狀結構層與層之間厚度遞減，腐蝕膜重 量與鋁溶蝕量也隨頻率增加而減少。採用正弦波和方形波時，頻率的影響結果大致相同，然而正弦波生 成腐蝕膜結構為層狀結構，而方形波所形成的腐蝕膜除層狀腐蝕膜外，尚具有覆蓋形式之沈積膜。發現在硝酸液中，探討正負半週期電量的影響，隨正半週期電量增加，蝕孔由細小蝕孔轉變為粗大蝕 孔，粗化也由均勻粗化轉變成不均勻的粗化的表面，腐蝕膜的厚度也隨正半週期電量增加而遞減，鋁溶 蝕量則隨電量增加而增加;負半週期電量增加時，蝕孔變為得更細小，腐蝕膜則呈現單層厚實的沈積， 鋁溶蝕量則隨負半週期電量增加而減少。又在鹽酸液中粗化時，當正半週期電量增加時，鋁溶蝕量遞增 ，蝕孔形貌從粗化轉成電蝕，最後出現粗大的方形蝕孔，且粗化不均勻，正半週期電量於TA/TC=10後， 蝕孔底部呈現半圓形蝕孔形貌，蝕孔孔壁沈積一層較薄的腐蝕膜;負半週期電量增加時，粗化現象則由均 勻分佈的蝕孔轉變成不均勻的粗化，腐蝕膜則是許多孔洞區隔的多層結構，鋁溶蝕量因腐蝕膜的大量沈 積而遞減。 最後，在硝酸中探討正負半週期電流密度峰值比值的影響，當負半週期電流密度峰值遞減時，鋁板表 面會由粗化轉變成均勻溶蝕，腐蝕膜會轉變成單層的腐蝕膜結構且易從蝕孔表面剝離，但在未受到侵蝕 的平坦表面，仍有一層很薄且與鋁底材緊密接合的氧化膜; 當正半週期電流密度峰值遞減時，蝕孔仍為 半圓形所構成，但因正半週期電量減少使蝕孔的數目逐漸減少，同時沈積了厚實的層狀結構腐蝕膜。



關鍵詞 : 平版印刷、電解粗化、腐蝕膜、鋁溶蝕量


**目錄**



**參考文獻**


1.H. TERRYN, AND J. VEREECKEN AND G. E. THOMPSON, "AC ELECTROGRAINING OF ALUMINUM",TRANS. IMF, VOL.66,

1988, PP. 116-121. 2.C. S. LIN,C. C. CHANG AND S.H. HSIEH, "PIT GROWTH OF 1050 ALUMINUM PLATES ELECTROGRAIN -ED IN A NITRIC ACID,"JOURNAL OF THE ELECTROCHEMICAL SOCIETY,VOL.147,NO.10,OCTOBER 2000 ,PP3647-3653. 3.C. S. LIN,C. C. CHANG AND H.M.FU,"AC ELECTROGRAINING OF ALUMINUM PLATES IN A HYDROCHL -ORIC ACID,"MATERIALS CHEMISTRY AND PHYSICS, 68, 2001, PP 217-224. 4.C. S. LIN AND H.M.FU, "ETCH FILM AND PIT STRUCTURE OF AA1050 ALUMINUM PLATES ELECTROGR -AINED IN NITRIC AND HYDROCHLORIC AICDS,"JOURNAL OF THE ELECTROCHEMICAL SOCIETY, VOL. 148,NO. 3,MARCH 2001, PP 240-246. 5.H. SAKAKI, A. SHIRAI AND A.OHASHI, "AC ELECTROLYTICALLY GRAINING ALUMINUM SUPPORT FOR MAKING A LITHOGRAPHIC PLATE AND PRESSENSITIZED LITHOGRAPHIC PRINTING PLATE," US PATENT 4301229,1981. 6.B.KERNIG, B. GRZEMBA AND G. SCHARF, "AC GRAINING OF LITHOGRAPHIC SHEET IN HYDROCHLORIC ACID," TRANS. IMF, VOL. 70, NO. 4,1992, PP. 190-194. 7.P. LAEVERS, H. TERRYN, J. VEREECKEN, B. KERNIG AND B. GRZEMBA, "THE INFLUENCE OF MANGA -NESE ON THE AC ELECTROLYTIC GRAINING OF ALUMINUM," CORROSION SCIENCE,VOL.38,NO.3,1996, PP. 413-429. 8.G. J. MARSHALL AND J. A. WARD, "INFLUENCE OF MICROSTRUCTURE ON ELECTROGRAINING BEHAVIO -UR OF COMMERCIAL PURITY ALUMINUM USED FOR LITHOGRAPHIC PRINTING PLATES," MATERIALS SC -IENCE AND TECHNOLOGY, VOL.11, OCTOBER 1995, PP. 1015-1023. 9.P. LAEVERS, H. TERRYN, J. VEREECKEN AND G. E. THOMPSON, "A STUDY OF THE MECHANISM OF A.C. ELECTROLYTIC GRAINING OF ALUMINUM IN HYDROCHLORIC AND NITRIC ACID," CORROSION SCI -ENCE, VOL.35, NOS.1-4, 1993, PP. 231-238. 10.H. TERRYN, J. VEREECKEN AND G. E. THOMPSON, "THE ELECTROGRAINING OF ALUMINUM IN HYDROC HLORIC ACID－Ⅰ. MORPHOLOGICAL APPEARANCE," CORROSION SCIENCE, VOL.32, NO.11, 1991, PP. 1159-1172. 11.H. TERRYN, J. VEREECKEN AND G. E. THOMPSON, "THE ELECTROGRAINING OF ALUMINUM IN HYDROC -HLORIC ACID－Ⅱ. FORMATION OF ETCH PRODUCTS," CORROSION SCIENCE, VOL.32, NO.11, 1991, PP. 1173-1188. 12.P. LAEVERS, H. TERRYN, AND J. VEREECKEN, "COMPARISON OF THE A.C. ELECTROGRAINING OF AL -UMINUM IN HYDROCHLORIC AND NITRIC ACID," TRANS. INST. METAL FINISHING, VOL.70, NO.3, 1992, PP. 105-110. 13.J-C. HUANG,"THE TREND IN ALUMINUM TREATMENT TECHNOLOGY FOR LITHOGRAPHIC PRINTING PLATE APPLICATION," PROC. SYMP. ALUMINUM SURFACE TREAT. TECH., 1986, PP. 2-18. 14.A.J. DOWELL, " THE ALTERNATING CURRENT ETCHING OF ALUMINUM LITHOGRAPHIC SHEET," TRANS. IMF, VOL.57, 1979, PP. 138-144. 15.G. E. THOMPSON AND G. C. WOOD, "THE EFFECT OF ALTERNATING VOLTAGE ON ALUMINUM ELECTROD -ES IN HYDROCHLORIC ACID," CORROSION SCIENCE, VOL.18, 1978, PP. 721-746. 16.C. K. DYER AND R. S. ALWITT, "SURFACE CHANGES DURING A.C. ETCHING OF ALUMINUM," J. ELE -CTROCHEM. SOC.,VOL.128, NO,2,1981,PP300-305. 17.A.J. DOWELL, "THE INFLUENCE OF METALLURGICAL FEATURES IN A.C. ETCHING FOR LITHOPLATES ," TRANS. IMF. VOL.64, 1986, PP. 85-90. 18.M. P. AMOR AND J. BALL,"THE MECHANISM OF ELECTROGRAINING ALUMINUM SHEET IN NITRIC / BO -RIC ACID ELECTROLYTE," CORROSION SCIENCE, VOL. 40. NO.12, 1998, PP.2155-2172. 19.E. PLIEFKE, "PROCESS FOR THE ELECTROCHEMICAL GRAING OF ALUMINUM FOR USE AS PRINTING PL -ATE SUPPORTS," US PATENT 4671859,1987. 20.J. E. WALLS, "PROCESS FOR THE ALUMINUM SURFACE PREPARATION," US PATENT ,4502925,1985. 21.J. E. WALLS, R. L. DRAGON AND T. A. DUNDER, "ELECTROGRAINING OF ALUMINUM WITH HYDROGEN PEROXIDE AND NITRIC OR HYDROCHLORIC ACID, " US PATENT,4336113,1982. 22.R. GUMBINNER AND T-C. HUANG, "PROCESS FOR ELECTROLYTIC GRAINING OF ALUMINUM SHEET," US PATENT,4052275,1977. 23.M. C. LLOYD AND S. C. PARISH, "PROCESS FOR ELECTROLYTIC GRAINING OF ALUMINUM," US PATE -NT,3980539,1976. 24.A.NISHINO AND T. KAKEI,"PROCESS FOR PRODUCTION ALUMINUM SUPPORT FOR PRINTING-PLATE,"US PATENT 5045157,1991. 25.K. AONO AND H. SAKAKI, "PROCESS FOR PREPARING POSITIVE-ACTING PHOTOSENSITIVE LITHOGRAP -HIC ALUMINUM PRINTING PLATE PRECURSOR USING NITRIC ACID ELECTROLYTE FOR GRAINING," US PATENT 4824757,1989. 26.F. D. BOGAR AND R. T. FOLEY, "THE INFLUENCE OF CHLORIDE ION ON PITTING OF ALUMINUM," J. ELECTROCHEM. SOC., APRIL 1972, PP. 462-464. 27.A.NISHINO AND T. KAKEI,"PROCESS FOR PRODUCTION ALUMINUM SUOOPRT OF A PRINTING PLATE," US PATENT 5141605,1992 . 28.GOBBETTI,"ELECTROCHEMICAL GRAINING OF ALUMINUM ON ALUMINUM ALLOY SURFACE," US PATENT 5064511,1991. 29.JEN-CHI HUANG AND MT KISCO,"TWO STEP METHOD FOR ELECTROLYTICALLY GRAINING LITHOGRAPHIC METAL PLATES," US PATENT 4721552,1988 30.W. M. MOORE, C. T. CHEN AND G. A. SHIRA, "A VOLTAMMETRIC INVESTIGATION OF AC CORROSION PHENOMENA AT AN ALUMINIUM ELECTRODE IN HYDROCHLORIC ACID", CORROSION SCIENCE, VOL.40, 1984, 644-649. 31.K. SHIMIZU, K. KOBAYASHI, P. SKELDON, G. E. THOMPSON AND G. C. WOOD, "AN ATOMIC FORCE MICROSCOPY STUDY OF THE CORROSION AND FILMING BEHAVIOUR OF ALUMINUM", CORROSION SCIEN -CE, VOL.39, NO.4, 1997, 701-718. 32.P. LAEVERS,A. HUBIN, H. TERRYN AND J.VEREECKEN,"A WALL-JET ELECTRODE REACTOR AND ITS APPLICATION TO THE STUDY OF ELECTRODE REACTION MECHANISMS PART Ⅲ: STUDY OF THE MECHA -NISM OF THE A.C. ELECTROLYTIC GAINING OF ALUMINIUM IN HYDROCHLORIC ACID", JOURAL OF APPLIED ELECTROCHEMISTRY, VOL.28, 1998, 387-396. 33.K. FUKUOKA AND M. KURAHASHI, "EFFECT OF SI-PRECIPITATE ON THE CAPACITANCE OF AC-ETCHIN -G AL ELECTROLYTIC CAPACITOR CATHODE FOIL," 住友輕金屬技報, VOL.31, NO.4, 1990, PP. 10 -17. 34.Y. TANNO AND E. SUGANUMA, "RESIN REPLICA

TECHNIQUE FOR SEM OBSERIATION OF PROGRESSIVE PITS PRODUCED DURING AC ETCHING OF ALUMINUM," 金屬表面技術, VOL.38, NO.8, 1987, PP. 31 -32. 35.T. SUZUKI AND Y. HAYASHI, "ELECTROLYTIC ETCHING OF ALUMINUM STRIP FOR LITHOGRAPHIC PR -INTING PLATES," 金屬表面技術，VOL. 30, NO. 10, 1979, PP. 541-546 36.西川泰久," ALUMINUM SHEET FOR PRESENSITIZED PRINTING PLATE,"日本輕金屬學會第49回研討 會論文集,1996, PP. 44-51. 37.森 輝雄著, "PS版的歷史與將來", 1994.PP. 9-14 38.楊邦朝,余忠, "低壓鋁箔交流腐蝕研究", 電子元件與材料, FEB.1998, PP.9-12. 39.鮮祺振，"金屬腐蝕膜特性探討",徐氏基金會，1998,PP115-130 40.羅福林，李興才，印刷工業概論，印刷工業研究所，1991. 41.張進春，林招松，"鋁板電解粗化之蝕孔形貌分析"，八七年中國材料科學學會年會論文集(D)，PP. 21-24. 42.張進春，傅學明，林招松，"平版印刷用1050鋁板在鹽酸液中電解粗化"，八八年中國材料科學學會 年會論文集，NO.880235. 43.張進春，"1050鋁板電解粗化之研究"，大葉大學碩士論文，1999，PP11-32. 44.傅學明，李佳盈，林招松"平版印刷1050鋁板以方形波及正弦波電解粗化之研究"，八九年中國材料 科學學會年會論文集 45.傅學明，"平版印刷用鋁版電解粗化之研究"，大葉大學碩士論文，2000，PP18-37.