磁場對奈米鎳磷合金之電催化活性研究

曹竣誠、李弘彬、李得勝

E-mail: 371963@mail.dyu.edu.tw

摘 要

本論文使用二次陽極氧化法製備陽極氧化鋁膜，以陽極氧化鋁膜做為結構模板，結合電解沉積法製備鎳奈米線與鎳磷合金奈米線，同時電解沉積製備鎳平板和鎳磷合金平板。藉由場發掃描式電子顯微鏡(FE-SEM)、穿透式電子顯微鏡(TEM)、震動樣品磁度儀(VSM)和X光繞射分析儀(XRD)對奈米線進行分析與觀察，獲得孔洞厚度為30μm、直徑為70~80nm陽極氧化鋁膜後，電解沉積鎳奈米線與鎳磷合金奈米線，在以0.5M H2SO4酸性溶液中，進行有磁場與無磁場環境對平板與奈米線做電化學量測。 研究結果顯示，在磁場與無磁場環境中，磁場有助於提升平板與奈米線的電催化活性；研究再藉由奈米效應增加比表面積，也有助於鎳奈米線與鎳磷合金奈米線對電催化活性的增加。

關鍵詞 : 鎳奈米線、鎳磷合金奈米線、電催化活性膜、氧化鋁膜

目錄

參考文獻

[1]M. M. Jaksic,“ Advances in electrocatalysis for hydrogen evolution in the light of the Brewer – Engel valence-bond theory, ” Int. J. Hydrogen Energy., Vol. 12, 1987, pp.727-752.

[2]許臣翔，“ 微構型鎳磷合金電鍍及其於硫酸溶液中電催化活性研究 ”，大葉大學機械與自動化工程學系碩士論文，2009年6月。

[3]馬振基，“ 奈米材料科技原理與應用 ”，全華圖書股份有限公司，2007年10月。

[4]王世宗，“ 於檸檬酸浴中電鍍鎳磷合金及其電催化性質 ”，國立台灣大學材料科學與工程學研究所論文，2006年6月。

[5]吳瑞文，“ 鎳磷合金電鍍層之內應力與磨耗研究 ”，大葉大學機械工程研究所碩士論文，2008年6月。

[6]楊文呈，“ 壓花輪模具鎳磷合金電鍍製程 ”，大葉大學機械工程學系碩士論文，2006年6月。

[7]張允誠、胡如南、向榮，“ 電鍍手冊（上冊） ”，第二版，國防工業出版社，北京，1997年。

[8]蘇葵陽、張良謙，“ 實用電鍍理論與實際 ”，復文書局，1986。

[9]N. K. Dirjal, et,al,Plat.“ The Role of Electroless Plating Bath Constituents in the Catalytic Oxidation of the Hypophosphite Ion, ” Plating and Surface Finishing., Vol. 85, 1998, pp.74-77 [10]J. L. Carbajal and R. E. White,“ Electrochemical Production and Corrosion Testing of Amorphous Ni-P, ” J.Electorchem Soc., Vol. 135, 1988, pp.2952-2957 [11]M. Ratzker, D. S. Lashmore and K. W. Pratt,“ Electrodeposition and Corrosion Performance of Nickel-Phosphorus Amorphous Alloys, ” Plating and Surface Finishing, Vol. 76,September 1986, pp.74-82 [12]E. Toth-Kafar, I. Bakonyi, A. Solyom,J. Hering and G. Konczos,“ Preparation and Characterization of Electrodeposited Amorphous Ni-P Alloys, ” Surface and Coating Technology, Vol. 31, 1987, pp.31-43 [13]R. Rajnarayan and M. N. Mungole,“ Electrodeposition of Ni-P Alloy Coatings, ” Surface Technology, Vol. 24, 1985, pp.233-239 [14]J. Crousier, Z. Hanane and J-P. Crousier,“ Electrodeposition of Ni-P Amorphous Alloys A Multilayer Strusture, ” Thin Solid Films., Vol. 248, 1994, pp.51-56 [15]鄧伊浚，“ 電鍍鎳鈷與鎳鐵合金組織與機械性質之研究 ”，大葉大學機械工程研究所碩士論文，2003年6月。

[16]陳黼澤，“鎳磷與鈷磷合金電鍍”，國立台灣大學材料科學與工程學研究所碩士論文，2005年7月。
[17]D. Baudrand,“ Nickel Sulfamate Plating,Its Mystique and Pracality,” Metal Finishing., Vol. 94, 1996, pp.15-18 [18]T. Morikawa, T. Nakade, M. YoKoi, Y. Fukumoto and C. Iwakura,“ Electrodeposition of Ni-P Alloys From Ni-Citrate Bath,” Electrochimica Acta., Vol. 42, 1997, pp.115-118 [19]R. L.Zeller, III and U.Landau,“ Electrodeposition of Ni-P Amorphous Alloys,” J. Electrochem. Soc., Vol. 139, 1992, pp.3464-3469 [20]G. McMahon and U. Erb,“ Structural Transitions in Electroplated Ni-P Alloys,” J. Materials Science Letters., Vol. 8, 1989, pp.865-868 [21]M. M. V. Parente, O. R. Mattos, S. L. Diaz, P. Lima Neto and F. J. Fabbi Miranda,“ Electrochemical Characterization of Ni-P and Ni-Co-P Amorphous Alloy Deposits Obtained by Electrodeposition,” J. Applied Electrochemistry., Vol. 31, 2001, pp.677-683 [22]T. M. Harris and Q. D. Dang,“ The Mechanism of Phosphorus Incorporation during the Electrodeposition of Nickel-Phosphorus Alloys,” J. Electrochem. Soc., Vol. 140, 1993, pp.81-83 [23]Kawashima, Y. P. Lu, H. Habazaki, K. Asama and K. Hashimoto,“ Structure and Corrosion Behavior of Electro-Deposited Ni-P Alloys,” Corrosion Engineering, Vol. 38, No 11, 1989, pp.643-653 [24]Brenner,“ Electrodeposition of Alloys,” Academic Press, New York, Vol. II, 1963, p.457.
[25]K. Masui, T. Nomura, S. Kwon and D. Chang,“ The Mechanism of Ni-P Alloy Deposition by Electroplating Method,” 表面技術, Vol. 43, 1992, pp.195-199.
[26]T. Morikawa, M. Yokoi, S. Shiroma, S. Eguchi and E. Kousai,“ Electroplating of Ni-P Alloys from Ni-Citrate Bath,” 表面技術, Vol. 43, 1992, pp.353-354.
[27]李鴻年、張紹恭、張炳乾、宋子玉，“實用電鍍工藝”，第一版，國防工業出版社，北京，1990年.
[28]Paseka,“ Evolution of hydrogen and its sorption on remarkable active amorphous smooth Ni-P(x) electrodes,” Electrochim Acta., Vol. 40, 1995, pp.1633-1640 [29]W.K Hu, Cao X.J, Wang F.P, Zhang Y.S.“ A Novel Cathode Foralkaline Water Electrolysis,” International Journal of Hydrogen Energy., Vol. 22, 1997, pp.441-443 [30]D. S. Lashmore and J. F. Weinroth,“ Pulse Electrodeposition of Nickel-Phosphorus Metallic Glass Alloys,” Plating Surface Finishing., Vol. 69, 1982, pp.72-76 [31]G. Lu, P. Evans,“ G. Zangari, J. Electrochem,” Soc., Vol. 150, 2003, A551 [32]B. Borresen, G. Hangen, and R. Tunold,“ Hydrogen evolution on RuxTi1?xO2 in 0.5 M H2SO4,” Electrochim Acta., Vol. 47, 2002, pp.1819-1827 [33]E. J. Kelly and H. R. Bronstein, J. Electrochem ”, Soc, Vol. 131, 1984, p.2232 [34]B. E. Conway and B. V. Tilak,“ Behavior and Characterization of Kinetically Involved Chemisorbed Intermediates in Electrocatalysis of Gas Evolution Reactions,” Advances in Catalysis., Vol. 38, 1992, p.41 [35]A.Lasia, Curr. Top. Electrochem, Vol. 2, 1993, p.239 [36]E. R. Gonzalez, G. Tremiliosi-Filho, and M. J. De Giz, ibid, Vol. 2, 1993, p.167 [37]A. Lasia and A. Rami, J.“ Kinetics of hydrogen evolution on nickel electrodes,” Electroanal. Chem., Vol. 294, 1990, pp.123-141 [38]A. Lasia,“ Study of electrode activities towards the hydrogen evolution reaction by a.c. impedance spectroscopy,” Int . J. Hydrogen Energy., Vol. 18, 1993, pp.557-560 [39]J. P. O ’ Sullivan and G. C. Wood,“ The morphology and mechanism of formation of porous anodic films on aluminium,” Proc. Roy. Soc.Lond. A., 317, 1970, pp.511-543 [40]Hoar, T. P. and Yahalom, J.“ The initiation of Pores in anodic oxide films formed on aluminum in acid solutions,” J. Electrochem Soc. 110, pp.612-614 [41]Dell ’ Oca, C. J. and Fleming, P.J.“ Initial Stages of Oxide Growth and Pore Initiation in the Porous Anodization of Aluminum,” J. Electrochem Soc. 123, 1976, pp.1487-1493 [42]Keller, F., Hunter, M. S. and Robinson, D. L.“ Structural Features of Oxide Coatings on Aluminum,” J. Electro. Soc. 100, 1953, pp.411-419 [43]S. Setoh and A.Miyata, Sci. Pap. Inst. Phys. Chem. Res, Tokyo, 1932, p.2772 [44]Masuda, H. and Fukuda, K.“ Ordered Metal Nanohole Arrays Made by a Two-Step Replication of Honeycomb Stuctures of Anodic Alumina,” Science, 268, 1995, pp.1466-1468 [45]F. Li, L.Zhang, and R.M.Metzger,“ On the Growth of Highly Ordered Pores in Anodized Aluminum Oxide,” Chem. Mater. Vol. 10, 1998, pp.2470-2480 [46]G. E. Thompson,“ Porous anodic alumina fabrication characterization and applications,” Thin Solid Films , Vol.297, 1997, pp.192-201 [47]H. Msuda and M. Satoh,“ Fabrication of Gold Nanodot Arrary Using Anodic Porous Alumina as an Evaporation Mask,” Jpn. J. Appl. Phys., Part 2 Vol. 35, 1996, pp.L126-L129 [48]Y. Kanamoria, K. Hane, H.Sai, H. Yugami,“ 100nm period silicon antireflection structures fabricated using a porous alumina membrane mask,” Appl. Phys. Lett. Vol. 78, 2001.
[49]白春禮，“奈米科技現在與未來”，凡異出版社，pp.30~41。
[50]張立德，“ Nanomaterials”，五南圖書出版社，pp.63~67。
[51]RAO“ Elements of Engineering Electromagnetics Third Edition(林振漢譯)”，高立圖書有限公司，pp85~125。
[52]L.C.Shen,and J.A.Kong“ Applied Electromagnetism Third Edition(吳清水&曾振東譯)”，全華科技圖書股份有限公司，14-2~14-19。
[53]蔡丕椿，蔡明雄，陳文照，廖金喜，“材料科學與工程”，全華科技圖書股份有限公司，4-55~4-70。