Electroplating Process of Ni-P Alloy on Inprinting Roller Mold

楊文呈、李春穎

E-mail: 9511164@mail.dyu.edu.tw

ABSTRACT

The forming molds of precision machinery and optical components must have high mechanical strength, high hardness, and high wearing resistance to bear the stress while the material is formed. Meanwhile, the material must have good corrosion resistance to avoid the surface deterioration during forming. Therefore, Ni-P alloy is one of the best choices. In this study, the pulsating current was adopted to be the power source. It can raise the phosphorus content in the film, improve the current efficiency and reduce the internal stress as well. The stable revolution of the cathodic electrode can result in uniform electroplating films. Good design of the tank and circulation system can raise the fluidity of electroplating solution, and make it easy to eliminate the hydrogen bubbles the plating surface. During electroplating, the distribution of electric field affects the uniformity of deposition thickness, and the non uniform electric field may result in the variation both in phosphorus content and mechanical properties. Therefore, with the simulation of electric field and design of cathode mask using ANSYS, the current could be distributed uniformly to the center of cathode, and Taguchi method was adopted to study the optimum parameter in the process.

Keywords : Ni-P alloy plating, pulsating current, Taguchi method

Table of Contents

REFERENCES

[1]. S. Y. Cho,P. R. Krauss, and P. J. Renstorm, “ Nanoimprint L ithography ” , Applied Physics Letters, Vol.67, No.21, pp.3114-3116, 1995 [2]. H. Tan, Gilbertson, and S. Y. Chou, “ Roller nanoimprint lithography, ” Journal of Vaccuum Science and Technology B, Vol.16, pp.3926－3928,1998 [3]. D. S. Lashmore and J. F. Weinroth, “ Pulse Electrodeposition of Nickel-Phosphorus Metallic Glass Alloys, ” Plating Surface Finishing, Vol.69, pp.72-76,1982 [4]. 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 [5]. 許倍誠, “ 電鍍鎳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,2000 年2 月 [6]. 陳翩澤, “ 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 [7]. 蘇葵陽、張良謙, “ 實用電鍍理論與實際, ” 復文書局,1986年 [8]. M. Ratzker, D. S. Lashmore and K. W. Pratt, “ Electrodeposition and Corrosion Performance of Nickel Phosphorus Alloys, ” Plating and Surface Finishing, Vol.76, pp.74-82, September 1986 [9]. R. L. Zeller, III and U. Landau, “ Electrodeposition of Ni-P Amorphous Alloys, ” Journal of Electrochemical Society,Vol.139, pp.3464-3469,1992 [10]. J. Crousier, Z. Hanane and J-P. Crousier, “ Electrodeposition of NiP Amorphous Alloys. A Multilayer Structure, ” Thin Solid Films, Vol.248, pp.51-56, 1994 [11]. 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, pp.643-653, 1989 [12]. 楊錫杭、黃廷谷, “ 微機械加工概論, ” 全華科技圖書股份 有限公司,2004 年 [13]. N. S. Qu, K. C. Chan and D. Zhu, “ Surface roughening in pulse current and pulse reverse current electroforming of nickel, ” Surface and Coatings Technology, pp.220-224,1997 [14]. 曾元宏, “ 脈衝電流應用於微電鑄最適化之研究, ” 國立清 華大學化學工程學系,碩士論文,2001 年 [15]. 許仁哲, “ 內應力對無電鍍鎳銅磷析鍍於鋁基材上影響之 研究, ” 國立成功大學材料科學及工程學系, 博士論 文,2004 年 [16]. R. Weil, “ The Origins of Stress in Electrodeposits Review of the

Literature Dealing with Stress in Eletrodeposited Metal, ” Plating, Vol.58, pp.643-653, 1971 [17]. C. S. Lin, C. Y. Lee, F. J. Chen, and C. Li, “ Structural Evolution and Internal Stress of Nickel-Phosphorus Electrodeposits, ” Journal of Electrochemical Society, Vol.152, No.6, pp.370-375, 2005 [18]. 林震、林進誠等, “ 機械工程實驗（一）材料實驗, ” 新科 技書局,1989 年 [19]. 白育倫, “ 實驗設計法應用於鎳磷共層鍍材料及電化學特 性之研究, ” 國立中正大學化學工程研究所,碩士文,2000年 [20]. 蘇朝敦, “ 產品穩健設計 ” ,中華民國品質管制學會 [21]. 羅錦興, “ 品質設計工程指引 ” ,中國生產力中心 [22]. 田口玄一,橫山撰子 “ 品質設計的實驗計劃法 ” ,中國生產 力中心 [23]. 陳耀茂譯, “ 田口實驗計劃法 ” ,滄海書局