High-strength Copper Alloy and Its Composite Electrodeposition

張靜芳、李春穎, 林招松, 張舜長

E-mail: 9419520@mail.dyu.edu.tw

ABSTRACT

Copper has been widely used in industrial applications due to its excellent conducting properties both in thermal and electrical aspects. However, the inferiority in mechanical strength makes the scope of its application restricted. Therefore, improving the mechanical strength, while retaining the conducting properties, becomes an important research topic. During the last decades, most studies in the composite electroplating concentrated on the enhancement of the codeposition of alumina in copper matrix. The discussion on the relationship between the material property and microstructure of the composite coating is rarely seen in the literature. A closed electroplating system was fabricated in this thesis and an experimental study on the effect of process parameters for this alumina/copper codeposition was conducted. The field-emission scanning electron microscope (FE-SEM) and transmission electron microscope (TEM) were employed in the examination of the microstructure of the coating. On the other hands, X-ray diffraction (XRD), energy dispersive spectrometer (EDS) and hardness tester were used to study the correlation between the microstructure and mechanical properties. The results showed that the addition of cobalt or thallium ion in the electrolyte can increase the amount of codeposited alumina. Nevertheless, the codeposited alumina was only found near the surface of the coating instead of uniform distribution through the thickness. It is concluded that for the acid electrolyte of copper sulfide, the additive of Tl or Co ion, pH of the solution and process parameters can used to tune the preferred orientation, defect of the microstructure and the hardness of the coating.

Keywords : Alumina, Composite Electroplating, Preferred Orientation

Table of Contents

REFERENCES

[1]張允誠，胡如南，向榮，1997，電鍍手冊，國防工業出版社 [2]曾俱梁，陳均武等人編著，1997，電鍍工藝手冊，機械工業出版社 [3]L. P ’ eter, A. Czira ’ ki and L. Poga ’ ny, 2001,“ Microstructure and Giant Magnetoresistance of Electrodeposited Co-Cu/Cu Multilayers, ” Journal of the Electrochemical Society, 14, 83, C168.
[4]曾俱梁，吳仲達，陳鈞武，呂佩仁，秦月文，1997，電鍍工業手冊，機械工業出版社 [5]N. Guglielmi, 1972,“ Kinetics of the Deposition of Inert Particles from Electrolytic Baths, ” Journal of the Electrochemical Society, 119, 1009.
[6]J. Foster and B. Cameron, 1976,“ The Effect of Current Density and Agitation on the Formation of Electrodeposited Composite Coatings, ” Transactions of the Institute of Metal Finishing, 54, 178.
[7] 增子昇， 虫明克彥， 1977 ，“ Electrodeposition of Ni-Al2O3 Composites on Rotating Cylinder Electrode, ” 金屬表面技術, 28, 10, 534.
[8]增子昇，虫明克彥，1980，“ Deposition Kinetics of Alumina Particle During Electroplating of Nickel-Alumina Composites, ” 金屬表面技術, 31, 10, 523.
[9]增子昇，虫明克彥，1980，“ Deposition Kinetics of Alumina Particle During Electroplating of Nickel-Alumina Composites, ” 金屬表面技術, 31, 10, 541.
[10]增子昇，虫明克彥，1985，“ 分散型複合電鍍， ” Denki Kagaku, 53, 1, 45.
[11]J. P. Celis, J. R. Roos and C. Buelens, 1987,“ A Mathematical Model for the Electrolytic Codeposition of Particles with a Metallic Matrix, ” Journal of the Electrochemical Society, 134, 1402.
[12]J. Fransaer, J. P. Celis and J. R. Roos, 1992,“ Analysis of the Electrolytic Codepostion of Non-Brownian Particles with Metals, ” Journal of the Electrochemical Society, 139, 413.
[13]J. P. Celis, J. R. Roos and C. Buelens and J. Fransaer, 1991,“ Mechanism of Electrolytic Composite Plating: Survey and Trends, ” Transactions of the Institute of Metal Finishing, 69, 4, 133.
[14]T. W. Tomaszewski, L. C. Tomaszewski and H. Brown, 1969,“ Codeposition of Finely Dispersed Particles with Metals, ” Plating, 1234.
[15]J. R. Roos, J. P. Celis and J. A. Helsen, 1977,“ Codeposition of Alpha- and Gamma-Alumina with Copper from Copper Sulphate Baths, ” Transactions of the Institute of Metal Finishing, 55, 113.
[16]E. S. Chen, G. R. Lakshiminarayanan, F. K. Sauter, 1971,“ The Codeposition of Alumina and Titania with Copper, ” Metallurgical Transactions, 2, 937.
[17]G. Wu, N. Li, D. Zhou and K. Mitsuo, 2004,“ Electrodeposited Co-Ni-Al2O3 Composite Coatings, ” Surface and Coatings Technology, 176, 157.
[18]V. V. Grinina and Y. M. Pokukarov, 1985,“ Effect of Periodic Current on the Incorporation of Foreign Particles in Electrolytic Copper Deposits, ” Insititute of Physical Chemistry, Academy of Sciences of the USSR, Nov., Russia.
[19]李建成，1987，“ 銅/氧化鋁複合電鍍動力學之研究， ”碩士論文，國立清華大學化學工程學系 [20]H. Hayashi, S. Izumi and I. Tari, 1993,“ Codeposition of α-Alumina Particles from Acid Copper Sulfate Bath, ” Journal of the Electrochemical Society, 140, 2.
[21]謝培煥，2002，“ 鎳-氧化鋁複合電鍍行為對鍍層性質之影響， ”碩士論文，國立成功大學化學工程學系 [22]蔡梨暖，2002，“ 鈷銅合金電鍍之研究，碩士論文，大葉大學機械工程研究所 [23]C. S. Lin, C. Y. Lee, C. F. Chang, C. H. Chang, 2005,“ Annealing Behavior of Electrodeposited Ni-TiO2 Composite Coatings, ” Surface and Coatings Technology, in press.