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STUDY FOR DEVELOPMENT OF AN ADDITIVE FOR SEMI-BRIGHTNESS FINISH FOR NICKEL ELECTOPLATING

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Abstract

A new additive for semi-brightness finish in nickel electroplating, having a quarternary ammonium salt structure, has been developed in this study. The effectiveness of the new additive was tested in laboratory-scale eletroplating tests as well as in a full-scale factory plating line. An examination of the plated surface showed that the new additive is as good as the one produced by the most commonly used additive in the nickel plating industry. The plated surface was examined by SEM, EPMA, and Reflectance Spectroscopy, and was found to be compatible to the one obtained with commercial additives. The new additive has a shelf life comparable with those of other commercially available additives. The additive developed in this study has an excellent potential to be used commercially.

Key words : *Nickel electroplating, Semi-brightness finish, Satin effect, Plating additives, Quarternary ammonium salt*

1. INTRODUCTION

In nickel electroplating, semi-brightness finish is often desired to obtain a satin-like appearance, and such finish is increasingly in demand in metal parts used in automobiles, cameras, audio equipment, cosmetics containers, and manyothers[1]. For semi-brightness finish, tipycally four additives are added in small quantities to the basic nickel electroplating bath. Though all four are required for a synergetic effect, only one is directly involved in giving the semi-brightness finish.

In this syudy, a new additive having a quaternary ammonium salt structure was considered for semi-brightness nickel electroplating finish. Various quarternary ammonium salts have been used for an additive for semi-brightness finish[3),4),5),6)]. Results of laboratory as well as factory plating line tests indicate that the new additive considered is as good as the additives commercially available at present. Results of various microscopic analyses also indicate that the new additive can be a commercially viable new product.

2. EXPERIMENTAL

Laboratory-Scale Electropalting Tests : Using a Hull Cell, nickel electroplating tests were conducted to examine the effectiveness of the new additive. The plating bath was composed of 470 g/l of $NiSO_4 \cdot 6H_2O$, 30 g/l of $NiCl_2 \cdot 6H_2O$, 35 g/l of H_3BO_3, and four additives including the new additive developed in this study (The other three additives were purchased from a local plating solutions supplier). Experimental conditions were as follows. Temperature : 45~53℃ ; pH : 4.1~4.6 ; cathodic current density : 3 amp /dm2 ; plating time : 5~7min[1]. The concentration of the new additive was varied from 3 wt.% to 7 wt.%.

Surface Analyses : For an appearance examination, SEM, Electron Probe Microscopic Analysis, and Reflectance Spectroscopy were used.

Plating Line Test : Using basically the same solution used in the laboratory tests, field tests were conducted in a nickel electroplating company to confirm the laboratory test results.

Surface Life Examination : For commercial viability, visual examination was performed for storability and decomposition behaviour during use.

3. RESULTS AND DISCUSSION

The results of the laboratory plating tests showed that, when the new additive considered in this study was used at 5 to 7 wt.%, it produced a semi-brightness finish quite comparable to that obtained by the use of a commercially available additive. The SEM micrographs showed that, at 5 wt.% or higher, the surface of the nickel loses its brightness and shows a satin-like appearance that is quite comparable to the one obtained by using 3 wt.% of a commercially available additive.

The results of the Reflectance Spectroscopy further confirmed that, when the concentration of the new additive exceeded 5 wt.%, the difference in brightness (DE* value) between the surface obtained by using the new additive and the one using a commercially available one was 0.31, indicating that the difference was negligible[7].

Factory plating line tests further confirmed the laboratory test results. The semi-brightness surface finish produced by the new additive on automobile parts was quite acceptible when plating experts examined the parts visually and by using optical microscope.

The new additive was found to be commercially viable in that storability was quite compatible to the available additives and that its behaviour during use is also acceptible.

4. SUMMARY AND CONCLUSION

A new additive for semi-brightness nickel electroplating finish was examined for its commercial viability. The new additive considered has a quaternary ammonium salt structure. Various tests and analyses have been performed to examine the effectness of the new additive. The results showed that, when it is used 5 wt.% or higher (typically up to 7 wt.%), the new additive produced a semi-brightness finish as compatible as the one obtained by using a commercially available additive. The new additive can be an excellent commercial product because of its good storability and the behavior during use.

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