

Influence of the Complexing Agents on the Thickness Uniformity of Electroless Nickel Plating

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Introduction

Electroless plating has been extensively applied to electronic devices, since it provides superior throwing power and uniform film formation for complicated geometries. In this study, the formation of the conductive layer in the deep-recessed trenches using electroless Ni-B plating was investigated. Uniformity of plating films was greatly influenced by the selection of the complexing agent. Dependence of selected complexing agent to the initial plating reaction was investigated by the electrochemical analysis.

Experimental

Ceramics comprising of trenches of aspect ratios of 1, 3, 5 and 7 were used as a sample. Deposition thickness uniformity was evaluated using electroless nickel plating baths containing glycine and DL-malic acid as a complexing agent. After degreasing and acid treatment, Pd catalysts were deposited on the sample with sensitizing and activation, and then followed by the deposition of nickel.

Immersion potential at the aperture part and the bottom area were measured to elucidate the initial plating reaction using a disc electrode and the trench-bottom electrode.

The QCM method was used to analyze a reaction mechanism during the initial plating reaction. The quartz crystal which deposited Pd nuclei by sensitizing and activation was immersed in the solution containing complexing agents, and the change of resonance frequency was measured.

Results

Figure 1 shows the cross sectional views of deposited nickel films in the trenches at aspect ratio 7. Superior uniformity of Ni films in the trench was obtained by the electroless plating bath containing DL-malic acid. On the other hand, Ni films from a bath containing glycine were not uniformly deposited and no deposition was obtained at the bottom of the trench.

Dependence of selected complexing agent to the initial plating reaction was investigated by the electrochemical analysis. As shown in Figure 2, the induction time was about the same on the disc and the trench-bottom electrodes from the DL-malic acid bath. On the other hand, the induction time was extended at the trench-bottom electrode from the glycine bath.

Figure 3 shows the changing of the resonance frequency, the frequency of glycine containing solution was rapidly changed to the dissolving direction, compared with the case of the solution containing DL-malic acid. This phenomenon is due to the dissolution of Pd catalysts from the quartz crystal. Therefore, before the plating reaction in the glycine bath, Pd

may have dissolved from the bottom area of the trenches during the induction time and result in the termination of the deposition reaction.

Conclusion

Uniformity of the plated films thickness was greatly influenced by the complexing agents.

Glycine bath showed longer induction time than DL-malic acid bath. Pd catalyst might be dissolved during the induction time, causing less deposition at the bottom of the trench in the glycine bath.

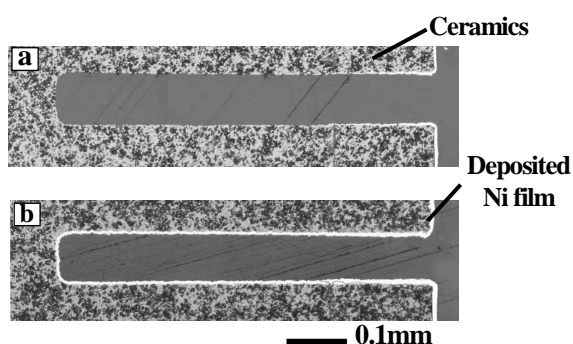


Fig.1 Cross-sectional views of trenches after electroless Ni-B plating (aspect ratio 7)
(a)Glycine bath, (b)DL-malic bath

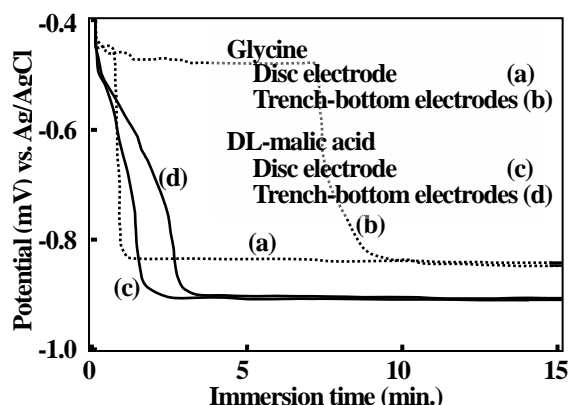


Fig.2 Immersion potential curves for electroless nickel plating

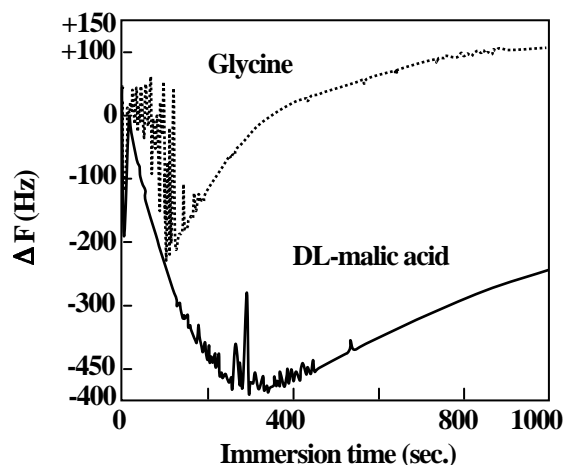


Fig.3 The change of resonance frequency.