Application of the electroless plating method to the fabrication of metallic bus electrodes of PDP

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Abstract

In the present study, the electroless plating method was applied instead of the sputtering as a formation method of metallic bus electrodes. No additional blackening step is needed in this method since this process provides a metallic seed layer with black color by a single step. The parameters which affects color and morphology of the metallic seed layer in the electroless plating solution were investigated

1. Introduction

Until present time, the bus electrode for PDP has been usually fabricated by using a FODEL (photosensitive silver process of Dupont) process[1]. The minimum width of the electrode was about 50μm in this process and the silver paste for the electrode fabrication was expensive.

However, it is expected that the width of the bus electrode becomes thinner than 50μm in the near future because the number of cells for a 70-inch HDTV PDP amounts to 6 millions[2]. The thickness of the electrode should be thicker in order to reduce the width keeping the same resistance. However, the formation of thick electrode in the FODEL process is very difficult since silver powders used scatter or reflect the ultra violet light easily. This process, therefore, does not seem to be adopted for a next generation PDP of which cell needs more fine electrodes.

To cut down the width of the electrodes maintaining the resistance of those, some researchers have proposed a method[3] which comprises photolithography and electroplating. The procedure is as follows. Conductive double layers are deposited on the ITO glass by using sputtering. First layer is for adhesion and blackening, second layer for electroplating. A photoresist was patterned on the sputtered surface by photolithography and then a metal is deposited by electroplating. Finally, both the photoresist and a needless conductive layer are removed by proper solutions.

In the present study, the electroless plating replaced the sputtering in the formation of metallic bus electrodes for reducing costs. The parameters, which affected on the color and morphology of the metallic seed layer in the electroless plating, such as composition, temperature and pH of the plating solution were investigated.

2. Experimental

The surface of an ITO glass was pretreated for the electroless plating. And then the ITO glass was immersed into a plating bath which consists in nickel and zinc sources. A black seed layer is deposited on the surface pretreated. The thickness of layer could be controlled by a plating time. After electroless plating, the photoresist with the thickness of 15 μm was patterned on the coated surface. The nickel metal was electro-deposed at the exposed area of photoresist. After the photoresist is stripped, the black seed layer exposed is etched out by an etching solution. Finally only the nickel electrode was remained on the ITO glass.

3. Results and discussion

In a special nickel solution, the black metallic seed layer on the ITO glass could be obtained by using an elctroless plating. Figure 1 shows the surfaces of (a) a nickel layer on the ITO glass, (b) a seed layer with electroless plating and (c) a nickel layer on the seed layer. The nickel layers of (a) and (c) in figure 1 are electrodeposited at the same current densities and times. The thickness of nickel deposited varied with a distance and the end area of ITO glass was not

deposited in figure 1 (a). However, the surface with the black seed layer was uniformly deposited in figure 1 (c). Figure 1 indicates found that the seed layer obtained has good conductivity and black color.

In the electroless plating method, the deposition rate and morphology of the black seed layer are much dependent on the bath composition. In particular, metal ion complexing agents have an effect on the adhesive strength between a seed layer and ITO glass. The seed layer, therefore, could be stripped together with a photoresist in the stripping process when the strength is weak owing to the improper agent. Even an incorrect selection of the pH control agent may lead to a big trouble in an etching process.

The proper conditions of the electroless plating for black seed layer on ITO glass are as follows.

- *Reducing Agent : Sodium hypophosphite*
- *Ni Source : Nickel sulfate*
- *Zinc Source : Zinc sulfate*
- *Bath temp. & pH : 70 –90 oC & 9 – 12*
- *pH control agent : NH_4OH or NaOH or Both*
- *Some Additives*

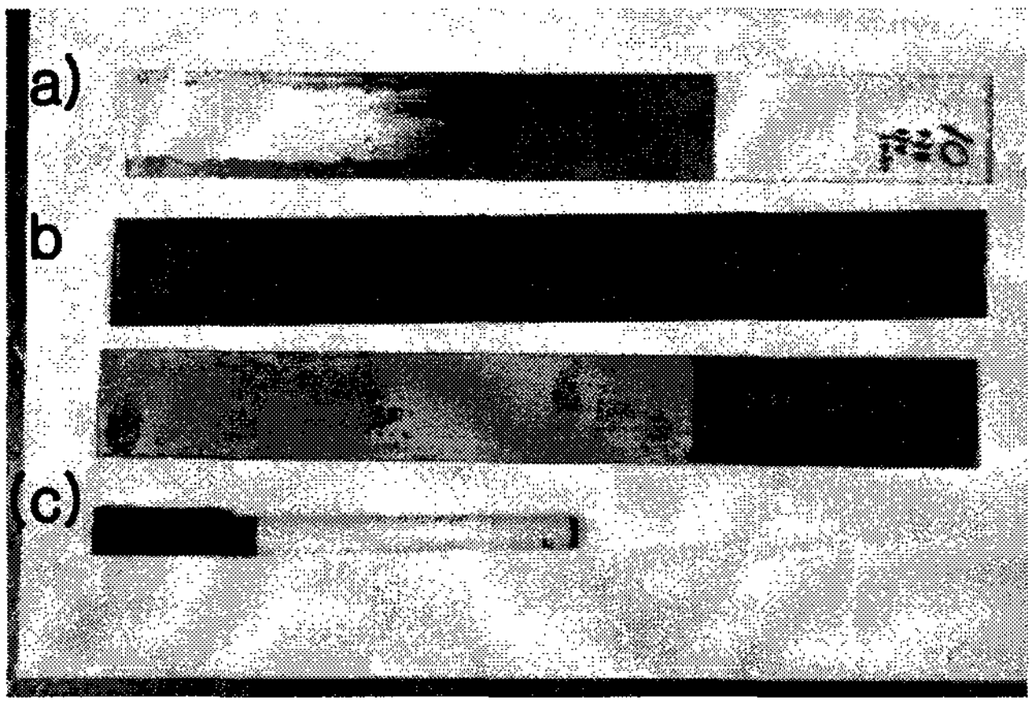


Figure 1 Photographs of the coated surfaces.

The optical photographs of the patterns with the width of 50μm are shown in Figure 2. Figure 2 (a) and (b) show the photoresist patterned on the black seed layer by photolithograph and Ni deposited on the photoresist pattern by using the electroplating method, respectively. Figure 2 (c) shows the bus electrodes without photoresist and needless black seed layer after the etching process. It seemed that some leftover black seed layer still has been attached to the nickel electrodes after the etching process.

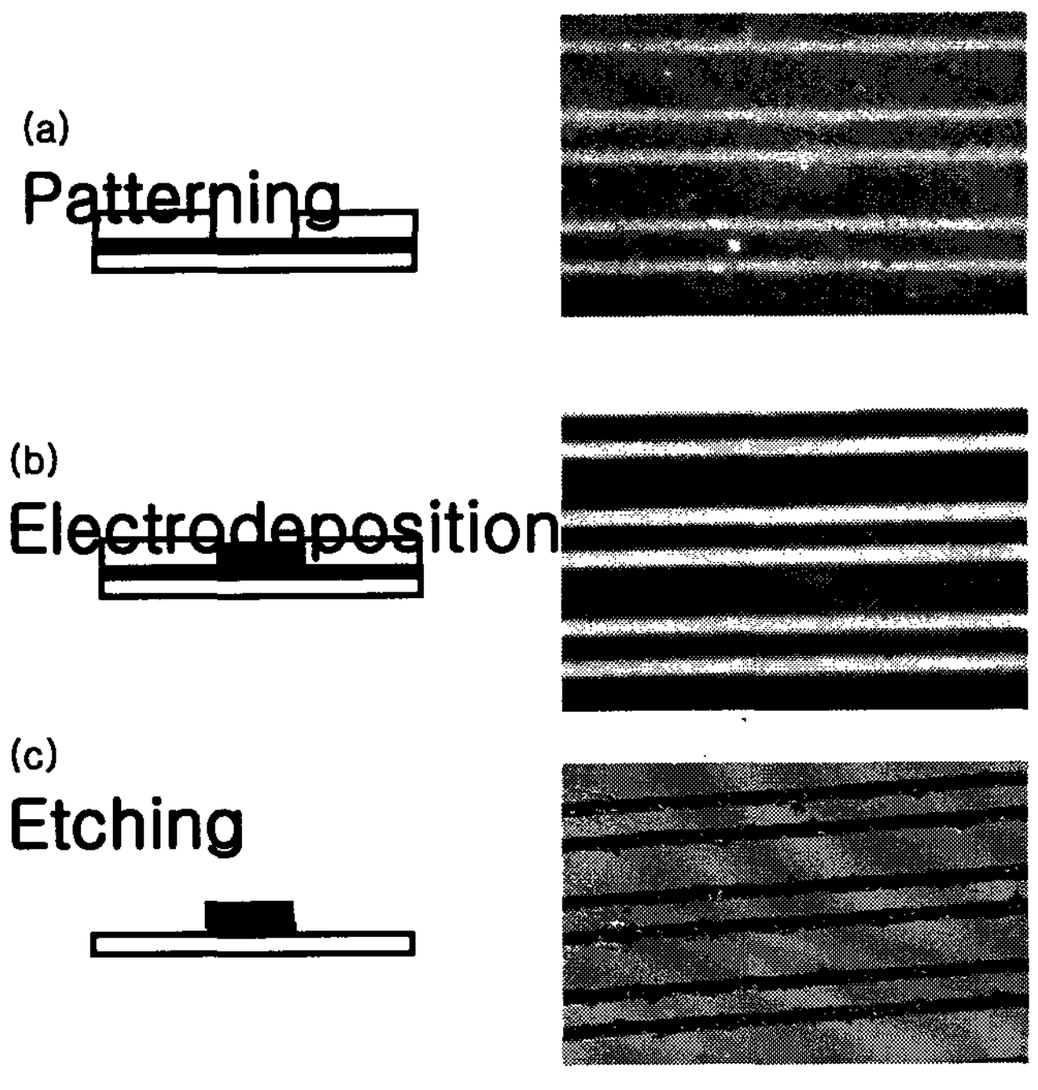
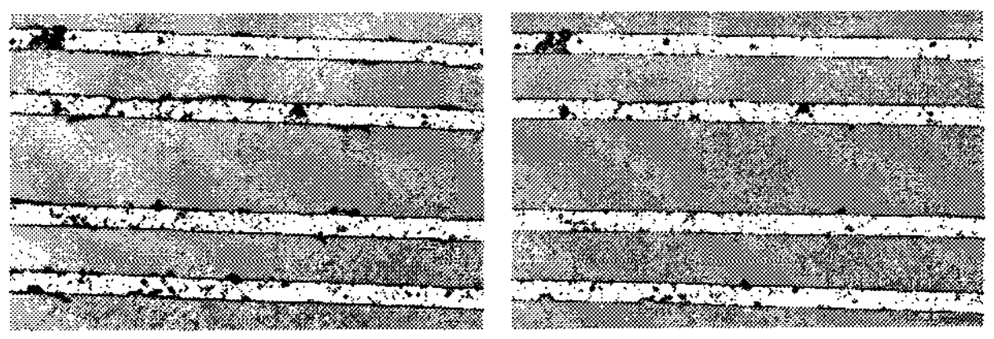


Figure 2 Optical photographs of the electrodes with the width of 50 μm.

Varying the composition of etching solution or the intrinsic properties of seed layer would be a possible solution to reduce the remains of seed layer. In the present study, however, these residues were removed by using the electro-corrosion method in which the seed layer is acted as an anode and some potential was applied. Figure 3 (a) and (b) shows the optical photographs of electrodes before and after applying potential, respectively.



(a) (b)

Figure 3 Optical photographs of the electrodes after the etching process.

(Applied potential (a) 0 V vs. o.c. (b) 5 V vs. o.c.)

4. Conclusion

The electroless plating conditions of the black seed layer for PDP was developed.

Application of electroless plating to the formation of metallic seed layer may allow a cost attractive and simple process since this process provides the black metallic layer by single step.

5. References

1) http://www.Dupont.com/displays/fodel. Html

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3) http://www.k-ids.or.kr/science/conference