

**Silver Electroless Plating
on Substrate Activated by Gold**

for Interconnection in Microelectronic Device

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Ag is considered to the candidate for the latest interconnection material in ULSI, TFT-LCD and PDP due to the lowest resistivity. But, the formation of Ag thin film is too hard since Ag agglomerates easily. In this paper, Ag electroless plating on substrate activated by Au is performed to keep Ag from agglomeration.

The crystal structure of Au is f.c.c., which is identical with that of Ag. And, the lattice parameter of two metals is almost same. Thus, Au is bonded easily and strongly with electrolessly plated Ag, which results in non-agglomeration and good adhesion of Ag with the substrate. Since the reduction potential of Ag is high, i.e. 1.83 V vs. NHE, Au activation is easily generated by displacement reaction. Because Au does not agglomerate, it is easy to obtain thin film. The resistivity of Au is $2.4 \mu \cdot \text{cm}$ which is relatively low value. Moreover, metal oxide between the interfaces is not generated since Au is not oxidized.

But, Au activation has not been studied at all. In this paper, this is attempted as pretreatment procedure for Ag electroless plating at first.

The structure used in this experiment was TiN (100 nm)/Ti (150 nm)/Si. Prior to Au activation, Ti oxide should be removed by 1% HF solution. Au activation solution consists of AuCl_3 and HF. Ag can be plated by electroless plating technology on the substrate activated by Au.

As the result of Ag electroless plating for 2.5 min on the substrate activated by Au, Ag clusters did not agglomerate at all and deposited uniformly throughout the substrate (Fig. 1). Incubation time was measured to know the time to form Ag film. From Fig. 2, incubation time was known to 2.3 min which informed that incubation time was very short. When Ag electroless plating was carried out for 10 min, Ag film with $2.4 \mu \cdot \text{cm}$ of the resistivity and 170 nm of the thickness could be obtained (Fig. 3(a)). Because Ag agglomeration was not generated by Au activation, smooth Ag film with 14.7 nm of surface roughness was resulted from Ag electroless plating for 10 min (Fig. 3(b)).

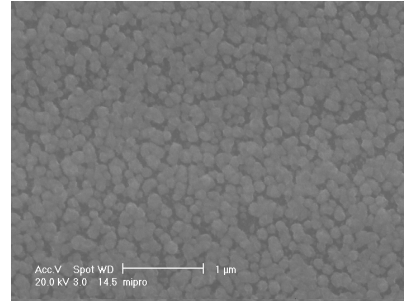


Fig. 1. FESEM top view of Ag film deposited for 2.5 min on the substrate activated by Au.

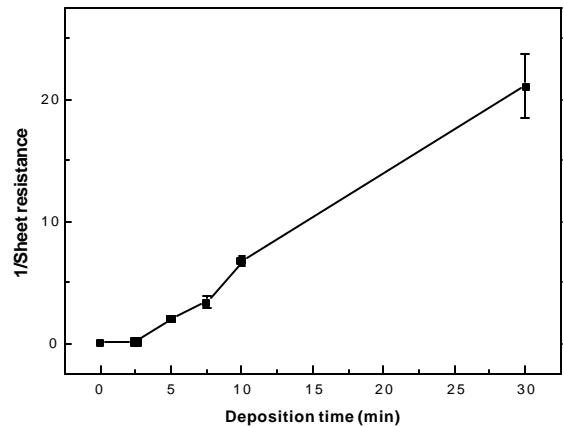


Fig. 2. The measurement of incubation time

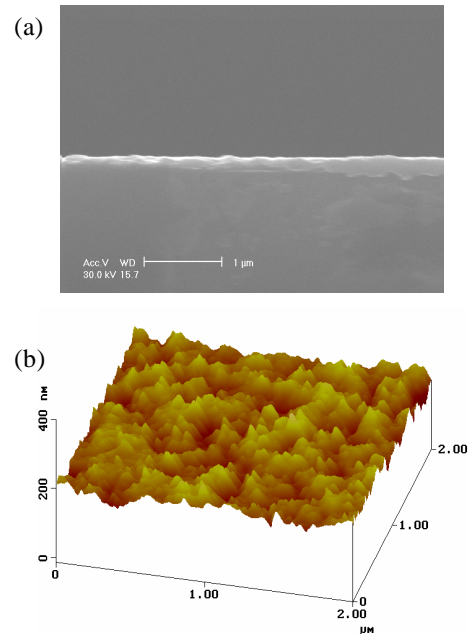


Fig. 3. (a) FESEM cross sectional view and (b) AFM image of Ag film deposited for 10 min on the substrate activated by Au.