Corrosive Behavior of Tungsten in EKC Solution in the Presence of Chloride

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Wet cleaning for resist strip and polymer removal has become more challenging with the continuous increases in density and number of interconnections and shrinkage of feature sizes in semiconductor industry. Amine based chemistries such as EKC are the most commonly utilized solutions [1] for removal of post etch residues from vias, contacts and metal lines. Typically the solvent strip process is followed by a DI water rinse step to remove the chloride. One main issue in the process of metal etch and post-etch cleaning is metal corrosion (W, Al/Cu, Ti, etc) due to the amine or hydroxylamine ingredients in the cleaning solution and chloride residues from chlorine-based etching process [2]. The prevention of corrosion of metals requires understanding of the interaction between chloride [3,4] and the metals and also the effect of various process parameters such as temperature, device structure [5], etc.

In the present work, the corrosive behavior of W in EKC solution at room temperature and 65°C in the presence of DI water and chloride has been investigated by using Tafel curve, AC impedance measurement and scanning electron microscopy (SEM). The electrochemical investigation of W has been performed using the following 4 electrolytes: EKC, EKC:HCl (0.1M), EKC:DI water(1:1), EKC:DI water(1:1):HCl. Figure 1 shows Tafel plots for W in these four different solutions at room temperature and 65°C. At room temperature, the corrosion current estimated from Tafel slope In EKC solution is almost the same as that in EKC solution with addition of 0.1M HCl. However, in EKC:DI water(1:1), the corrosion current is almost 6 times larger than that in EKC solution and the open circuit potential (OCP) shifts to more negative value by about 100 mV. This negative OCP indicates that W is less stable and more susceptible to corrosion. The addition of HCl (although small amount) further increases the corrosion current. At 65°C, the behaviors are similar. Addition of DI water and HCl increases the corrosion currents and shift OCP to more negative values. These results show that H_2O and HCl have significant effect on the corrosion rate on W by accelerating the electrochemical interaction between W and chloride and solution ingredients. SEM image (Figure 2) gives direct evidence of formation of corrosion pits in EKC:H_2O(1:1):HCl solutions at 65°C. Detailed results and discussion will be presented at the meeting.

Reference:

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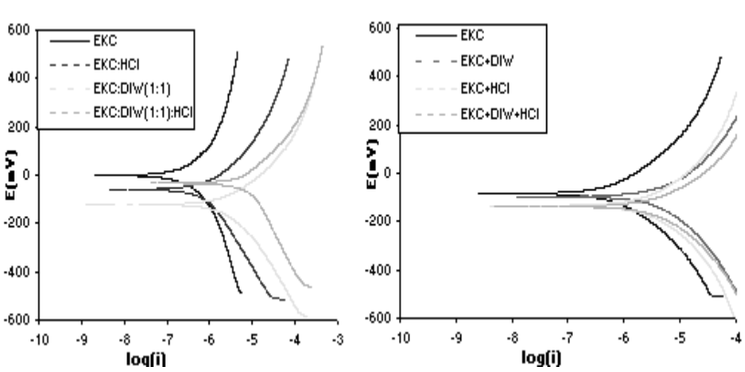

Figure 1:Tafel curves of W on four EKC-based electrolytes (a) At room temperature (b) At 65°C

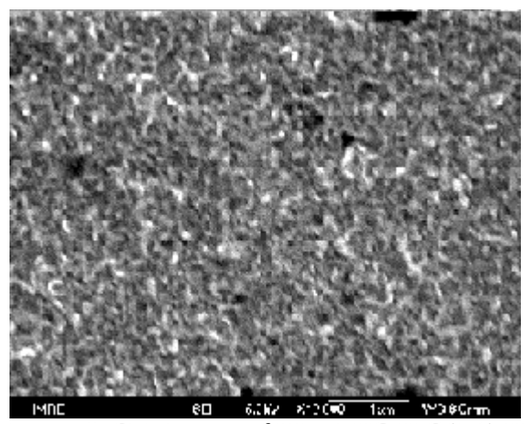

Figure 2: SEM image of W in EKC:H_2O(1:1):HCl