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Copper Platinum Deposition via DC and Pulsing Techniques Using A New Bath

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In order to improve the mechanical properties of copper, a new pyrophosphate bath employing chloroplatinic acid was developed to allow for codeposition of copper and platinum. Cyclic voltammetry experiments were conducted on the electroplating bath, and with baths containing platinum precursor and copper precursor.

Current densities ranging from 1 to 4 A/dm^{-2} and temperatures from 20 to 60^{o}C were employed for the DC electrodeposition experiments. Bright, shiny and crack-free deposits were obtained at low current densities (i.e. 1-2 A dm^{-2}). The amount of platinum observed in deposits was found to increase with the current impressed and temperature of the bath. The Knoop hardness was found to increase with platinum content of the deposits. The corrosion rate of the deposits measured in a solution of NaCl was found to decrease with platinum content.

Three different peek current densities (2.5, 5.0, and 7.5 A dm^{-2}) were employed to study Cu-Pt electrodeposition under forward pulse and reverse pulse conditions. The duty (forward) cycle was 66.7% calculated from on and off times of 8 and 4s, respectively. Deposits produced at 2.5 and 5.0 A dm^{-2} were found to be very ductile. As the peak current density was increased from 2.5 to 5.0 and then to 7.5 A dm^{-2}, the deposits were found to be less smooth and duller in appearance. The reverse duty cycle of 80% was calculated from on and off times of 4 and 1 s respectively.

As compared to the deposits obtained using forward pulse, deposits were found to be much smoother and free of blemishes. Pulse reversal also led to an enhancement in platinum content of 13-55%. The data also show that deposits using pulse reversal method have lower corrosion rates (Figure 1) than those produced using forward pulse technique. In addition, deposits produced by pulse reversal method were found to have 10% greater Knoop hardness (Figure 2) than the ones obtained using forward pulse technique.

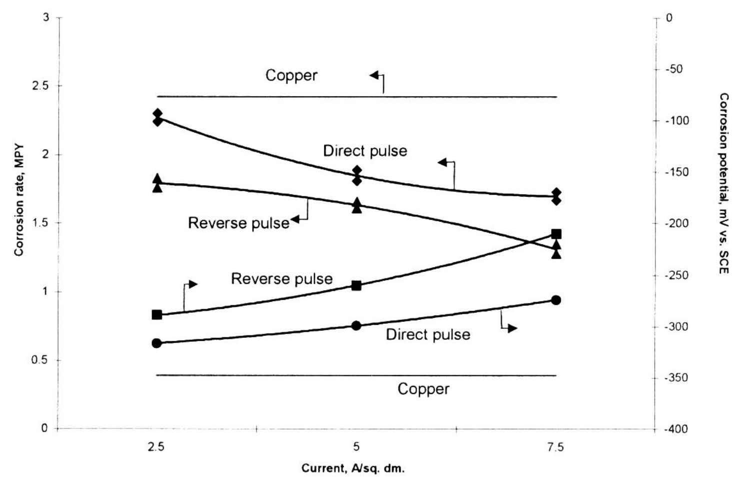

Figure 1. Corrosion rate and potential vs. applied current density

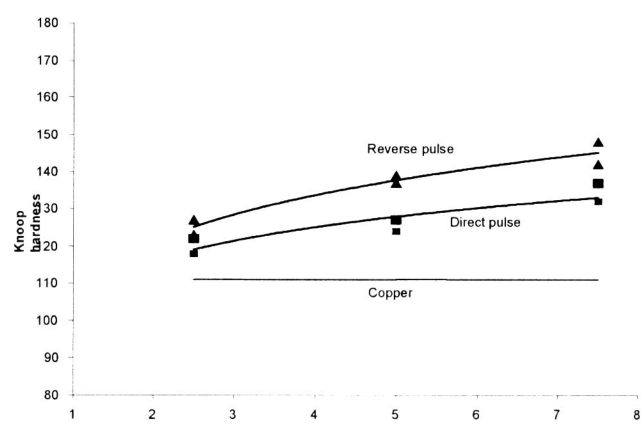

Figure 2. Knoop hardness vs. forward peak current