

Superconformal deposition of Au in a Sulfite Electrolyte
D. Josell and T.P. Moffat
Materials Science and Engineering Division, NIST
100 Bureau Drive, Gaithersburg, MD 20899

I describe a process for superconformal electrodeposition of gold in submicrometer Damascene trenches and present electrochemical measurements that elucidate the mechanism and provide kinetics for modeling and prediction. The gold sulfite electrolyte contains sodium sulfite as a supporting electrolyte and lead perchlorate as an accelerating additive.

Measurements including cyclic voltammetry (Fig. 1), chronoamperometry (Fig. 2) and potential pulsing are detailed. Taken together the results are shown to indicate that lead adsorption on the deposit surface over time is concentration and potential dependent.

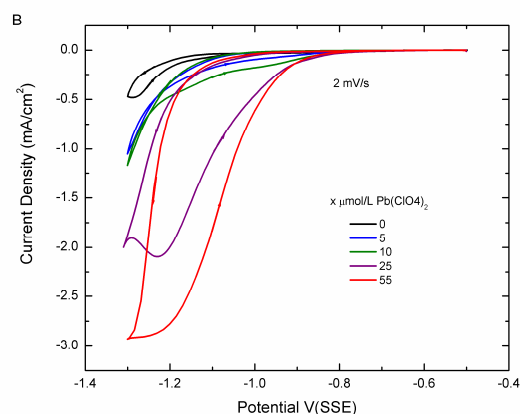


Fig. 1 Cyclic voltammograms showing the acceleration of Au deposition provided by lead perchlorate additive¹.

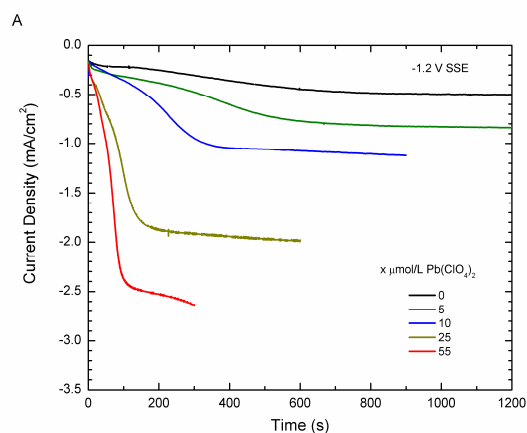
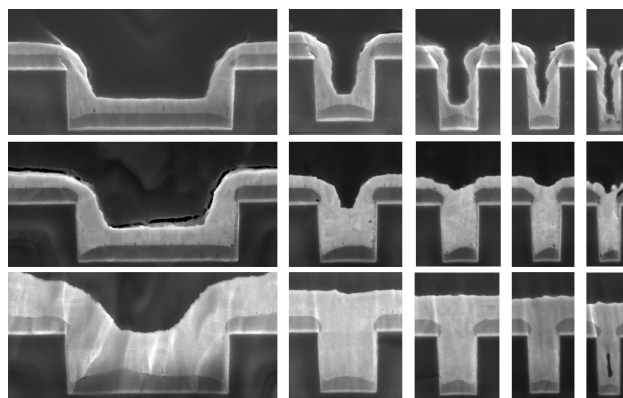


Fig. 1 Chronoamperometric measurements showing the acceleration of Au deposition provided by lead perchlorate additive¹.

The results of the electrochemical measurements are placed in the context of the curvature enhanced accelerator coverage (CEAC) mechanism²; the Pb adsorbate accelerates deposition, remains on the deposit surface during deposition and accelerates deposition at the bottoms of trenches where area loss increases the adsorbate coverage during feature filling. As a result superfill is predicted during deposition in patterned features. Experimental results are shown to validate the model predictions (Fig. 3).

Potential dependence of the steady-

state/saturation adsorbate coverage is significant. Processes including adsorbate burial as well as desorption are described and the impact of these factors on Au superfilling in this sulfite system, not a major concern in previously detailed Cu, Ag and Au superfilling systems, is discussed.



(1.5, 2, and 2.5) min, -1.2 V, 25 $\mu\text{mol/L}$ $\text{Pb}(\text{ClO}_4)_2$ 1 μm

Fig. 3: Superfill of submicrometer trenches with Au in the sulfite electrolyte¹.

1. D. Josell and T.P. Moffat, Superfilling Damascene Trenches with Gold in a Sulfite Electrolyte, *Journal of the Electrochemical Society*, 160(12), D3009-3014 (2013).

2. T.P. Moffat, D. Wheeler, W.H. Huber, and D. Josell, Superconformal Electrodeposition of Copper, *Electrochemical and Solid-State Letters* 4(4), C26 (2001).