

## Spontaneous potential oscillations in the Cu(II)-citrate system during Cu and Cu<sub>2</sub>O deposition.

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### Abstract

Spontaneous potential oscillations have been observed in the Cu(II)-citrate system (Fig 1) during galvanostatic deposition. The potential oscillations occur at  $5.9 < \text{pH} < 12.3$ , depending on the copper ion concentration and the citrate/Cu(II) molar ratio. The oscillation period is a strong function of temperature, pH and cathodic current density. Slow oscillations are desirable for *in situ* measurements, which will give increased knowledge about the oscillating system and the mechanism behind the oscillations.

When lactate and tartrate were used as a complex binder in alkaline solutions it was shown from X-ray diffraction (XRD) and transmission electron microscopy (TEM) measurements that the oscillations induced formation of composite films of Cu and Cu<sub>2</sub>O [1,2].

Cu and Cu<sub>2</sub>O are deposited in the Cu(II)-citrate system in an analogous way. The phase composition of the film can be investigated by XRD. The deposition process is however advantageously followed by the electrochemical quartz crystal microbalance (EQCM). The morphology of the surface is investigated by atomic force microscopy (AFM), (Fig. 2). *In situ* AFM was employed to follow the morphology changes during the deposition.

The mechanism of the spontaneous potential oscillations in the Cu(II)-citrate system will be discussed and compared to the analogous lactate and tartrate systems.

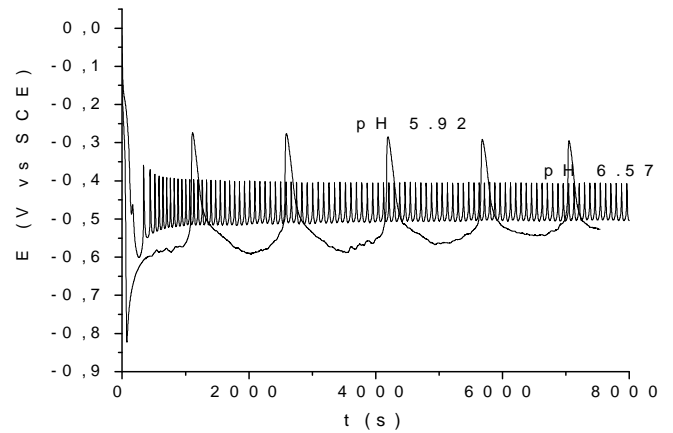


Fig. 1. Spontaneous potential oscillations in unstirred Cu(II)/citrate solutions at pH 5.92 and pH 6.57 on a Pt electrode and cathodic current density of 0.1 mA/cm<sup>2</sup>. T = 21 °C.

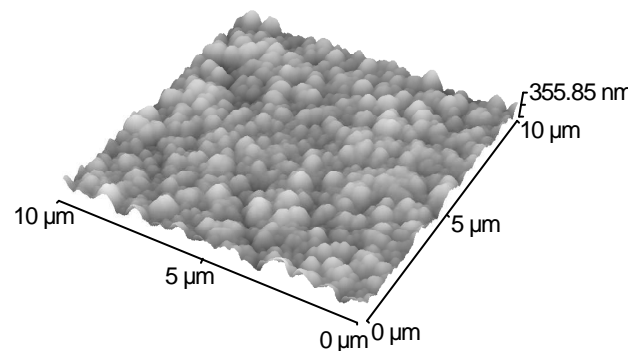


Fig. 2. Surface morphology of the Pt electrode as a result of deposition with a constant cathodic current of 0.1 mA/cm<sup>2</sup> in a Cu(II)-citrate solution at pH 6.11, T = 21 °C.

### References

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2. S. Leopold, M. Herranen, J-O Carlsson, *J. Electrochem. Soc.*, 148 (8) C513-C517 (2001)