A Rotating EQCM Study of the Effect of Electrolytes, Additives and Metal Impurities on the Electrodeposition of Gold(I) Thiosulfate.

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There is currently a lot of work being carried out on the use of thiosulfate as an alternative lixiviant for gold. However, most of this work has neglected the recovery of metallic gold from a gold(I) thiosulfate solution. The work presented here looks at the electroreduction of gold(I) thiosulfate and the effect of various electrolytes, additives and metal impurities.

There are two methods generally employed to recover gold from solution – namely cementation and electrowinning. This study on the electroreduction of gold is equally applicable to both processes as the cathodic reaction in each case is the same.

The use of a rotating electrochemical quartz crystal microbalance (REQCM) to study the deposition of gold is required since there are other side-reactions occurring simultaneously with gold reduction. The ability of the REQCM to make real-time mass measurements allows data on the gold reduction reaction to be obtained as the other reactions do not involve mass changes at the surface of the electrode.

Electrolytes with three different cations (Na^+, K^+ and NH_4^+) were investigated here. It has been previously [1] noted that changing the metal cation present in solution has a dramatic effect on the reduction of gold(I) thiosulfate. The results shown in figure 1 indicates that the deposition of gold is significantly enhanced in the presence of potassium or ammonium. However in sodium containing electrolyte, the reaction is significantly hindered.

During electrowinning, the presence of free thiosulfate is likely as it is freed and accumulates during the deposition of gold. In addition, free thiosulfate may be required in an elution process which produces the gold containing solutions. The effect of free thiosulfate addition to solution is shown in figure 2. It can be seen that the gold reduction becomes more difficult when free thiosulfate is present.

Finally, the effect of various additives and impurities in solution was investigated. Most of the leach solutions suggested in current literature contain ammonia. Hence, it would be conceivable that ammonia would be present in the solution from which gold is to be recovered. Gold ores also tend to contain significant amounts of other metals. The effect of metal impurities in solution have also been studied. In some cases, the deposition of these other metals (e.g. silver) might also be desirable during the recovery process.

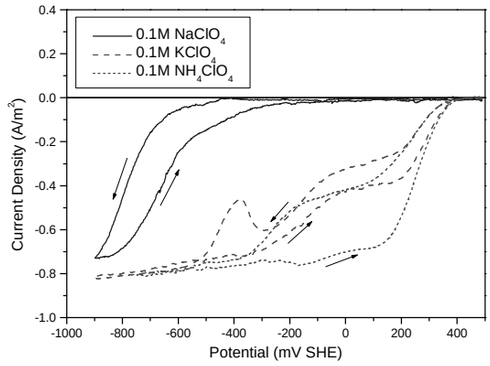

Figure 1: Voltammograms showing the electroreduction of gold(I) thiosulfate in 3 different perchlorate solutions.

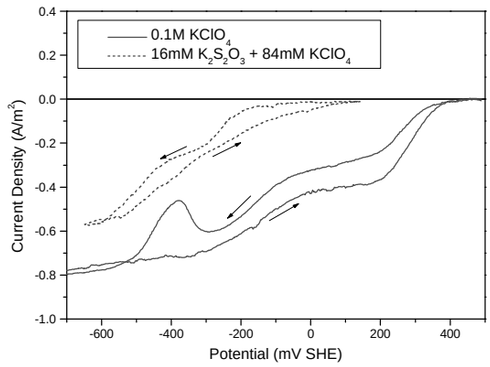

Figure 2: Potential scans showing gold(I) thiosulfate reduction in the presence of $KClO_4$ and/or K2S2O3

References:

1. W.L Choo and M.I. Jeffrey, “An Electrochemical Study of the Deposition of Gold from Gold(I) Thiosulfate Solutions with Minimal Free Thiosulfate”, presented at APCChE / Chemeca 2002, New Zealand