

Report

05/24/05

1. Corrosion Study of copper metal matrix with 2.7 vol% dispersed Al_2O_3 (DS Copper) vs pure Copper (Glidcop contains 0.7 vol% Al_2O_3): [Ref: Hongbin Sun, H. G. Wheat, Journal of Materials Science 28(1993)]

It was proved that corrosion behavior of DS copper is very similar or might be slightly better than copper. Although, a protective layer forms on both the alloys, initial corrosion rate of DS copper is higher than pure copper due to high energy interfacial area between the matrix and the Al_2O_3 particles or galvanic effect between Cu and Al. But it was observed that after the formation of the protective layer corrosion rate of both the materials is very similar.

The following pictures depicts that corrosion surface of DS copper is rougher than pure copper. I have a speculation that in APS, along with turbulence, rougher surface of Glidcop might also promote higher deposition on some particular components.

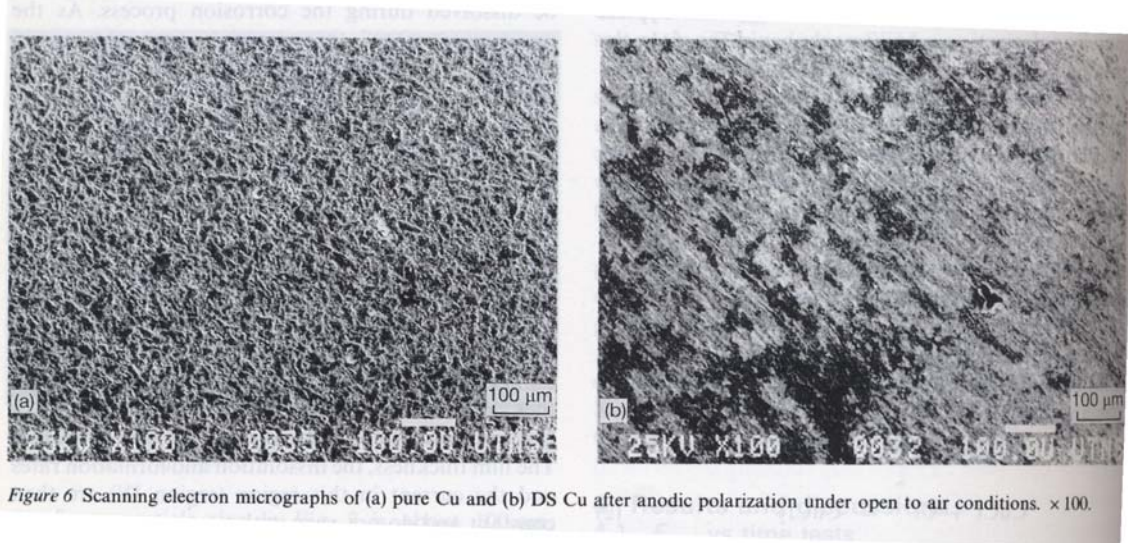


Figure 6 Scanning electron micrographs of (a) pure Cu and (b) DS Cu after anodic polarization under open to air conditions. $\times 100$.

2. Relation between ECP & ORP [Ref: Telma Carvalho, Walter Bogaerts, Valtion Teknillinen Tutkimuskeskus (VTT), issue 212 (2001) pp473-486]:

Telma Carvalho and Walter Bogaerts have discussed corrosion of copper in pure water at 95°C temperature as a function of oxygen. They have considered the range for dissolved oxygen up to 900 ppb for their experiments. Their finding is comparable to the “DO vs Corrosion rate curve” at that temperature.

I have come across the term ORP (Oxidation Reduction Potential) in various corrosion related papers but did not find the relationship between ECP and ORP and the factors that affect ORP and how does this contribute to corrosion. This paper discusses both the terms and their relationship.

ECP (Electrochemical Corrosion Potential) is largely determined by the ORP of the aqueous solution. In turn, ORP is controlled by dissolved oxygen, pH, temperature and presence of any reducing agents in the aqueous medium. Correct determination of

ORP is very important because it determines the corrosiveness of the medium. By a series of experiments the author has proved that ORP measurements are not very consistent at lower DO level of pure water. Hence, it was suggested that determination of ECP is much reliable and useful than determining ORP in pure water for corrosion study.

Phase transformation between Cu_2O and CuO was detected by sudden change in current density. Precise ECP (Electrochemical Potential) for the phase transformation was determined as a function of dissolved oxygen. Potential for CuO formation is lower at a higher O_2 level (900 ppb) compared to lower O_2 level (350ppb) because at higher DO required overpotential for the formation of CuO decrease.

3. Can higher dissolved Oxygen increase redox potential? In one of my report I had mentioned about the process of using hydrogen to reduce redox potential (Y-axis of the Pourbaix diagram). Now as I have found out that ORP also affects redox potential and the fact that oxygen and hydrogen behave opposite way, I am wondering if aeration of water will bring the redox potential up to the CuO formation level.

4. Electrode Surface: Various books and websites mention that surface quality of the electrodes should be very good. Hence, I am planning to grind and polish a small Cu plate (of same composition as APS magnets have) to use as a working Electrode.