Formation of Metal Fog and Dissolved Metals during Electrodeposition from Molten Salts

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Laboratory experiments were performed to study the behaviour of so-called metal fog formed at the cathode during electrodeposition of liquid metals such as aluminium and lead from molten salts. Double potential step chronoamperometry was used to detect fog formed during electrodeposition of aluminium.

So-called metal fog is a visual phenomenon which is often observed in the electrolyte near the cathode during deposition of liquid metals from molten salts. Results from visual observations have been reported [1, 2, 3]. Metal solubility in molten salts leads to formation of coloured solutions suggesting that in some cases at least part of the fog is due to dissolved metal. Visual observations and studies of nucleation of magnesium during deposition from chloride melts indicated that the fog consisted of tiny Mg droplets formed by homogeneous nucleation from a supersaturated solution of dissolved Mg [4]. Fog formation was facilitated at cathodes with poor wetting properties.

Studies of metal fog were performed by visual observations and electrochemical measurements. Formation of metal fog was studied by double potential step measurements in molten Na_3AlF_6-AlF_3(10 wt%)-Al_2O_3 at 990^oC; cathodic polarization for 10 seconds followed by anodic polarization at 0.9 V until steady state. The cathodic potential was varied. Aluminium formed during cathodic polarization, will oxidize at 0.9 V. The anodic current was found to reach a steady value after a few minutes. Cathodic polarization at potentials more negative than -150 mV gave rise to abrupt fluctuations of the measured current during the anodic polarization. This behaviour was attributed to oxidation of particles in the melt. By integrating the current with time for these current peaks, it was possible to determine the size of the particles assuming they consist of Al. The radius of the droplets was in the order of 10 - 50 μm. Droplets of the same size were found in a similar study during magnesium deposition from chloride melts [5]. Effects of dissolved impurity species in the electrolyte on the fog formation were also studied. Results from similar studies during lead deposition from molten $PbCl_2$ were obtained.

References

1. Qui Zhuxian, Fan Liman, K. Grjotheim and H. Kvande, J. App. Electrochem., **17**, 707 (1987).

2. W.E. Haupin and W.C. McCrew, Aluminium, **51**, 273 (1975).

3. W.E. Haupin, R.S. Danchik and J.F. Luffy, Light Metals, **1**, 159 (1976).

4. G.M. Haarberg, S.R. Johansen, J. Melaas and R. Tunold, Proc. Seventh Int. Symp. Molten Salts, Volume 90-17, p. 449, 1990.

5. B. Børresen, "Electrodeposition of Magnesium from Halide Melts", Dr.ing. thesis, Department of Electrochemistry, NTH, Trondheim, January 1995.