The influence of the current density on the AC-graining morphology

Thanasis Dimogerontakis[a], Paola Campestrini[b], Herman Terryn[a]

[a]Department of Metallurgy, Electrochemistry and Materials Science, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

[b]Agfa-Gevaert, Septestraat 27, 2640 Mortsel, Belgium

AC-graining is extensively used in order to increase the surface area of the aluminium printing plates for offset applications. This surface treatment is a highly controlled electrochemically induced pitting process, involving the application of an alternating current in a suitable electrolyte. Under the alternating current, pitting and aluminium dissolution takes place during the anodic half period, while reduction of protons during the cathodic half period and the concomitant rise in the interfacial pH, provoke the formation of a passivating film, the smut layer, resulting in the redistribution of attack during the subsequent anodic half period.

In this work the influence of the current density on pit initiation and growth was investigated by examining the formed graining morphology. Samples from the aluminium alloy 1050 had undergone AC-graining in 0.34 M HCl at 37 ^{o} C with current ranging from 40 to 120 A dm^{-2}. The produced graining morphologies were examined by scanning electron microscopy and the distribution of the pits size, the mean value of the pits size and the pits population density were estimated by applying image analysis on the acquired micrographs.

It was obvious from the micrographs (Figure 1) that the increase of the current density influenced the graining morphology in the number and the size of the pits. It was also observed by the respective histograms from the image analysis that as the current density increased, the pits population density (P.P.D.) decreased, while the mean value (M.V.) of the pits size increased (Figure 2). The increase of the current density also caused a significant increase of the weight of the smut layer formed during the AC-graining (Figure 3). This increase came from the higher the current density, the larger the local concentration of aluminum ions inside the pits during the anodic half period. In addition, the current increase also caused a higher local increase of pH during the cathodic half period. Therefore, larger precipitation of aluminium hydroxide took place and larger amount of smut layer was formed.

Thus, it can be concluded that the increase of the smut layer formation, induced by the increase of the current density, resulted in a decrease of the population density of the pits and an increase of their size. This indicated that the pit initiation was hindered, while the pit growth was enhanced by the increase of the current density during the AC-graining.

Acknowledgments
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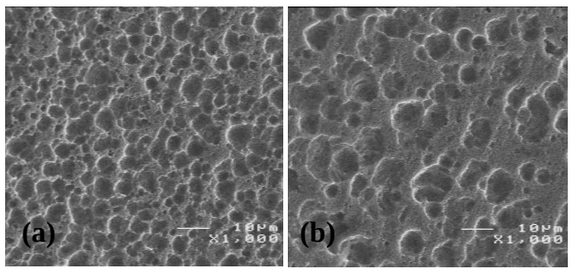

Figure 1: SEM micrographs (x1.000) of samples grained with 960 C dm^{-2} at (a) 40 A dm^{-2} and (b) 120 A dm^{-2}.

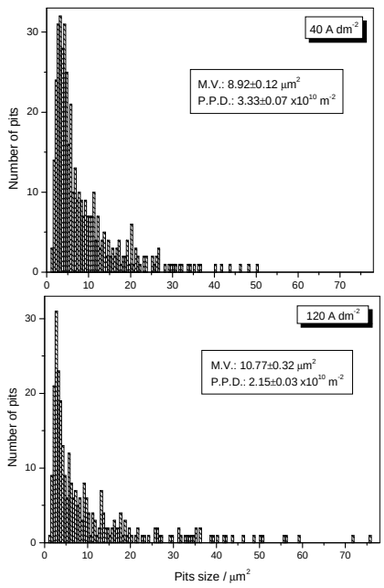

Figure 2: Distribution of the pits size for AC-graining with 480 C dm^{-2} at 40 and 120 A dm^{-2}

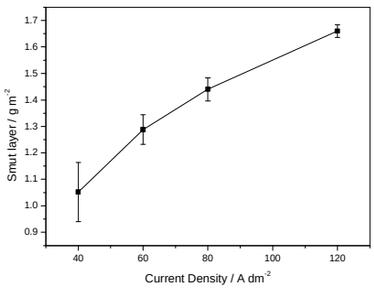

Figure 3: Smut layer weight for AC-graining with 1440 C dm^{-2} at 40, 60, 80 and 120 A dm^{-2}.