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HIGH SPEED VIDEO EVIDENCE FOR LOCALISED DISCHARGE CASCADES DURING PLASMA ELECTROLYTIC OXIDATION

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Abstract

Information is presented from high speed video imaging of the free surface of coatings being grown on aluminium substrates by PEO processing. The exposure time during image capture ranged down to 5.5 µs, while the linear spatial resolution of the images ranged upwards from about 12 µm. The area being viewed was about 2.4 mm^2, which was taken to be representative of the substrate area as a whole (~129 mm^2). PEO Processing was carried out at 50 Hz AC. The periods over which image sequences were captured was about 100 ms, covering several cycles of variation of the applied potential. This operation was repeated periodically while the coating thickness increased from a few microns to several tens of microns. During the imaging periods, it was typically observed that tens or hundreds of individual discharges were occurring, all of them readily distinguishable from the background light levels. Their duration was of the order of several tens of microseconds. It was noticeable that they tended to occur in "cascades" at particular locations, each sequence comprising tens or hundreds of individual discharges, with an "incubation" period between them of the order of several hundreds of microseconds. It seems likely that they all occurred during the positive (anodic) half-cycle, while the applied voltage was sufficiently high. An individual cascade tended to persist (at the same location) over several voltage cycles. As the coating became thicker, these characteristics broadly persisted, although individual discharges became longer-lived and more energetic. An attempt is made to relate these observations to the overall picture of how coating growth takes place during PEO processing, and also to the overall energy consumption.

Keywords: plasma electrolytic oxidation, cascades, electrical discharges, high speed photography.

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