ABSTRACT

A comparative study towards reanodization of thick (22 µm) porous anodic alumina coatings in aqueous and non-aqueous electrolyte solutions is performed. The kinetics of pore-filling and breakdown characteristics during reanodization demonstrate unanticipated development such as some persistence in voltage growth in aqueous environment and extremely sharp voltage drop at breakdown threshold in non-aqueous one. These findings could be most probably assigned to the irregular structure and complicated phase composition of thick porous coatings.

Keywords: anodic aluminium oxide, reanodization, breakdown voltage.

EXPERIMENTAL

The kinetics of pore-filling and breakdown behavior during re-anodization of porous anodic oxide films on aluminium are studied in two different (aqueous and non-aqueous) electrolytes - aqueous borate electrolyte (ABE) and ammonium salycilate in dimethylformamide (0.1M AS/DMF). Porous films are formed in 15 % sulfuric acid solution at current density $5 \times 10^{-3}$ A cm$^{-2}$ for 180 min. Under these conditions porous layers with a thickness of approximately 22 µm are formed [1]. The re-anodization is carried out at current density $1 \times 10^{-3}$ A cm$^{-2}$ for 1 hour. All studies were performed at room temperature. All these electrochemical procedures took place using two-electrode cell of working and auxiliary (Pt grid) electrodes, and a home-made high voltage galvanostat (600 V, 0.5 A). The formation voltage was controlled and recorded on a precision multimeter (Mastech MS 8050) along with a PC-based data acquisition system.

RESULTS AND DISCUSSION

As a result of these studies a series of re-anodization kinetic $U(t)$-curves are produced and are characterized with good reproducibility. An example of re-anodization curves derived using various electrolytes is presented in Fig. 1. It is interesting to note that in the kinetic curves shown, some peculiarities could be observed as well. In re-anodization in ABE, persistence in the values of voltage for a sizable period of time after reaching 150 V is observed. The emergence of breakdowns begins in about 3000 s which is quite unexpected. On the other hand, the curve recorded by pore-filling in 0.1M AS/DMF shows sharp voltage drop of approximately 600
volts at the first breakdown, compared to only 100 V in 1M AS/DMF [2]. Furthermore, comparing both curves a significant difference within the breakdown oscillations’ amplitude is obvious.

**CONCLUSIONS**

A series of re-anodization kinetic $U(t)$-curves is derived and they demonstrate very good reproducibility. The special features observed in the kinetic $U(t)$-curves for both electrolyte solutions are probably due to the large thickness of porous matrix, suggesting some peculiarities in the structure and phase composition of the porous part of the film. Furthermore, tenfold lower concentration of AS/DMF solution reveals a significant effect on the first breakdown as well.

**REFERENCES**