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Effect of Etch Tunnel Length Distributions of Aluminium Foil on Impedance Spectra in Aluminium Electrolytic Capacitor

알루미늄 전해 커패시터에서 알루미늄 foil의 etch tunnel 길이 분포가 임피던스 스펙트라에 미치는 영향

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Effect of etch tunnel length distributions of pure aluminium foil on electrochemical impedance spectra in aluminium electrolytic capacitor was investigated using scanning electron microscopy, electrochemical impedance spectroscopy and galvanostatic charging/discharging experiment. The aluminium capacitor-grade foil of 4 N purity was anodized in a 0.5 M H_3BO_3 + 0.05 M $Na_2B_4O_7$ solution at 1 mA cm^{-2} up to 150 V and then held at 150 V for a further 30 min. In the present work, transmission line model was modified taking into account the presence of the length distribution of aluminium etch tunnels on the assumption that fraction of tunnels dying per unit time holds constant. The resistive and capacitive elements in the proposed transmission line circuit were estimated by using complex non-linear least squares fitting method. From the transmission line circuit, current transients were simulated at a potential step during charging/discharging. It revealed that they accorded well in shape and value with those experimentally measured. The etch tunnel length distributions were characterized roughly with the help of scanning electron microscopy. From the experimental results, It was concluded that the impedance spectra are closely related to the tunnel etched structure of an aluminium foil and the proposed transmission line model is valid for the analysis of electrochemical impedance spectra obtained from an aluminum foil.

Reference

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