Optimization on the Etching Process of Aluminum Foil for Low-voltage Electrolytic Capacitor

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ABSTRACT

Aluminum electrolytic capacitors are the important electronic accessories, which are usually seen in the circuit system of the industry electronic product such as computer and power supply. The required quantity of the low-voltage capacitor can be reduced and the capacitor can be made in smaller dimensions if the anode foil surface can be increased satisfactorily. Therefore, the industry research projects focus on enlarging the anode foil surface and increasing its capacitance using chemical and/or electrochemical processes. Among them, the electrochemical etching is one of the most popular and promising methods to achieve this objective. For most common practices, the etched and formed aluminum foils with 99.99% purity in aluminum composition have been used as the anode material to fabricate electrolytic capacitor. It has been concluded that the effective surface area of aluminum foils would essentially control its capacitance. In this study, the AC-etching method was used to enlarge the surface area and increase the capacitance of etched aluminum foil. The electrochemical factors such as current waveform and frequency, current density, etching time, and corrosion solution factors such as composition, concentration and temperature were investigated. The effects of aluminum ions in the corrosion solution which influence etching efficiency and pit morphology were also studied. Important results are summarized as following: (1) Non-uniform passive oxide film formed on the foil surface should be removed by the immersion of aluminum foil in pretreatment solution. After this pretreatment, the pits are produced more easily and uniformly during the subsequent AC-etching. It is found that using the phosphoric acid as pretreatment solution, the pretreatment result is better than that of the other acids. (2) The shape of the surface pits were influenced by the current frequency, current density and waveform, and the composition of the electrolyte bath. (3) After AC-etching, the etched foil was formed at 18.4V in ammonium adipate solution for ten minutes and the capacitance reached 60~63 μF/cm2 under EIAJ- RC2364 specification. In etching the cathode aluminum foil, the chemical etching was adopted to increase its surface area. It is important that the cathode aluminum foil must be processed with stabilization treatment, wherein a surface thin oxide film was grown to prevent the capacitance decay. From the experimental results, the capacitance decay was within 10% and the capacitance remained 375 to 390 μF/cm2 after the hydration test of submerged into the boiling pure-water for an hour.

Keywords : Aluminum Electrolytic Capacitor、AC-etching Aluminum Foil、Cathode Etched Aluminum Foil

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