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Failure Mechanism for Metallized Film Capacitors under Pulsed Current

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For pulsed metallized film capacitors, the pulsed current would lead to the electrode fracture, which could further cause the decrease of capacitance, and the process could be accelerated when repetitive pulsed current passes. The pulsed current would further lead to the failure of metallized film capacitors, and shorten the lifetime of capacitors. Besides, the anatomical results of metallized film capacitors show the existence of electrode fracture. This paper analyzes the failure of metallized film capacitors when bearing large pulsed current, the criteria and the threshold value of the current density of electrode fracture are also studied. Moreover, experiments are carried out to study the electrode fracture when capacitors bear single pulsed current and repetitive pulsed current respectively, the experimental results indicate that the threshold value of the electrode fracture is $1.07 \times 10^{11} \text{ A/m}^2$ when the single pulsed current passes, and $1.39 \times 10^{10} \text{ A/m}^2$ when the repetitive pulsed current passes. Theoretical results are also derived based on the theory of Joule effect and the phase transition of metal, indicating that the threshold value of the electrode fracture is $1.30 \times 10^{11} \text{ A/m}^2$ when the single pulsed current passes, and $2.65 \times 10^{10} \text{ A/m}^2$ when the repetitive pulsed current passes. The theoretical results match the experimental results, indicating that the pulsed current would cause the electrode fracture, which would further result in the failure of metallized film capacitors.

Author: LI, Liwei (Huazhong University of Science and Technology)

Co-authors: Mr CHEN, Qiren (State Key Laboratory of Advanced Electromagnetic Engineering and Technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology); Mr HUANG, Xiang (State Key Laboratory of Advanced Electromagnetic Engineering and Technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology); Prof. LI, Hua (State Key Laboratory of Advanced Electromagnetic Engineering and Technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology); Mrs LI, Lu (State Key Laboratory of Advanced Electromagnetic Engineering and Technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology); Mr ZHANG, Qin (State Key Laboratory of Advanced Electromagnetic Engineering and Technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology)

Presenter: LI, Liwei (Huazhong University of Science and Technology)

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