THE COMPARATIVE ANALYSIS OF TECHNOLOGICAL REGIMES FOR IMPROVING THE ELECTRICAL INSULATION STRENGTH OF DOUBLE-SIDED ALUMINA BASES WITH VIAS

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I. INTRODUCTION

The aim of the presented research is developing of the methods and techniques using optimized technological regimes to improve the electrical insulation strength of anodic Al_2O_3 in vias of double-sided alumina bases for potential use in power multichip modules [1].

Preliminary experimental studies of fabricated alumina bases with vias matrices showed that in the process of electrochemical anodization at the junction of horizontal and vertical surfaces in vias, microcracks inevitably appeared due to anodizing fronts competing in different directions, restructuring of the porous structure and arising mechanical stresses, even if on the continuous surface of alumina bases, microcracks were completely absent.

II. RESULTS AND DISCUSSION

It was shown that the dielectric strength of anodic Al_2O_3 in vias increased by minimizing the number of microcracks due to vias have chamfers (at an angle of up to 45°), a smooth profile at the inputs with satisfactory roughness parameters were formed on the initial samples of aluminum bases by machining and due to the smoothing of microcracks during reanodization. Various methods and techniques were developed and investigated consisting the compositions of single- and multicomponent electrolytes and the electrochemical conditions of multistage anodizing for the beneficial (in terms of increasing the breakdown voltages in vias) structural rearrangement of anodic Al_2O_3 and the formation of multilayer elastic and flexible coatings with minimization of the number of microcracks and internal mechanical stresses. It was found that to ensure the high breakdown voltages, it is necessary to prime (fill the pores) of anodic Al_2O_3 and heal defective microcracks in vias with organosilicon varnish in an ultrasonic bath at a frequency of ~20-40 kHz at a maximum power of ~0,5 kW and temperature ~30 °C during 20 min. Moreover, this technological technique should be carried out in two cycles. Then after filling the excess varnish in the vias should be blowed out with compressed air and after removed from the surface with a squeegee and treated with a toluene solution, after which a multistage heat treatment procedure is carried out with a maximum temperature of 280 °C.

It was shown that after using of the appropriate technological methods the breakdown voltages of the obtained test samples (Figure 1 (a)) were up to ~6 kV on working surfaces without holes and up to ~2,5 kV in vias (Figure 1 (b)).

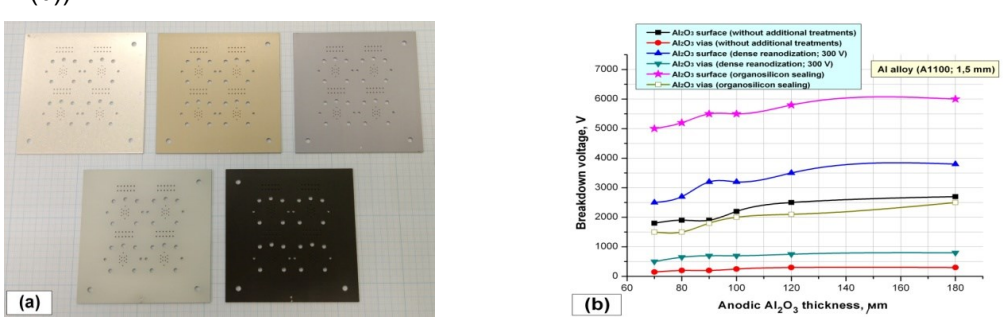

Figure 1. Photo of various double-sided alumina bases with vias (a) and comparative analysis of technological methods influence on the breakdown voltage (b)

III. CONCLUSIONS

Thus, the comparative analysis of optimized methods and technological regimes for improving the electrical insulation strength of anodic Al_2O_3 in vias of double-sided alumina bases for potential use in power multichip modules were discussed.

REFERENCES

[1] D.L. Shimanovich, V.A. Yakovtseva, "Electrochemical alumina technology for power electronics devices", Doklady BGUIR, Vol. 3 (121). pp. 5-11, 2019.