

적층 강압형 압전변압기 Ag/Pd 전극의 TiO₂ 와 PZT 분말의 첨가에 따른 효과연구 Effect of TiO₂ and PZT powder additions on the Ag/Pd Electrode for Step-down

Multilayer Piezoelectric Transformer

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Abstract : In order to fabricate the multilayer piezoelectric transformer by tape casting method, we investigated the effect of TiO₂ and PZT powder additions on the Ag/Pd electrode. Meanwhile, effects of TiO₂ and PZT powder additives on the microstructure and electrical properties of Ag/Pd electrode were investigated in detail. In addition, the multilayer piezoelectric transformers were fabricated and the characteristics with various load resistance were measured at resonance frequency. The voltage step-up ratio was continuously change with increasing input voltage and load resistance, and then output voltage and powers were increased with increasing input voltage at matching impedance. The temperature rise of multilayer piezoelectric transformers were increased with increasing input voltage and load resistance. Meanwhile, multilayer piezoelectric transformers sintered at 1100 °C show the favorable characteristics with a power of 15 W at 100 Ω.

Key Words : piezoelectric transformer, TiO₂, PZT, multilayer, step-down, electrode

1. Introduction

Piezoelectric transformers have been studied for many years and piezoelectric ceramics used for high-power device, such as transformers, actuators and ultrasonic motors, have been extensively studied [1,2]. Multi-layer piezoelectric transformers have the advantage of high density, large planar electro-mechanical coupling factor (K_p) and high mechanical quality factor(Q_m), however, that during the fabrication of multilayer devices, various defects nucleate and grow at the interface between the electrode and the ferroelectric ceramic layers. This is of particular concern during the co-firing process, when a mismatch in the sintering of the two materials (the ceramic and the internal electrode) can cause interfacial de-lamination, cracking and other defects. The objective of this study is to investigate the effect of the addition of TiO₂ and PZT powder to Ag/Pd electrodes on their properties and their sintering.

2. Experimental

The Rosen type Piezoelectric transformer were sintered at temperature of 1100 °C. The sintered material was fabricated as piezoelectric transformers with the size of 27×27×2.1mm. The Ag/Pd pasted with 10wt% TiO₂ powder, and finally heat treated at 1100 °C for 10 min. The piezoelectric transformers were poled at 120 °C for 30 min by applying field of 3 kV/mm in silicone oil bath. The Ag/Pd electrode without TiO₂ have a homogeneous microstructure and well-grown grains. However, the specimen doped with 10 wt% TiO₂ exhibited more uniform structure.

The temperature rise of multilayer piezoelectric transformers were increased with increasing input voltage and load resistance. Meanwhile, multilayer piezoelectric transformers sintered at 1100 °C show the favorable characteristics with a power of 15 W at 100 Ω. In this paper, multilayer piezoelectric transformers with high quality have been successfully manufactured using Ag/Pd electrode with 10wt% TiO₂ powder. Multilayer piezoelectric transformers sintered at 1100 °C show the favorable characteristics with a power of 15 W at 100 Ω.

Reference

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