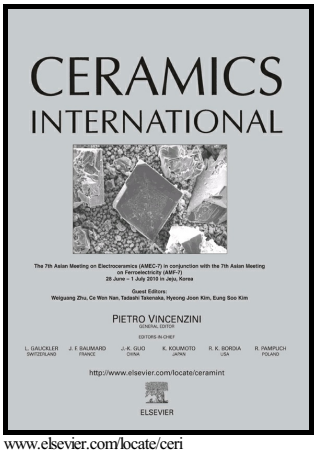

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Improvement of energy density in $SrTiO_3$ film capacitor via self-repairing behavior

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Abstract

Self-repairing behavior of $SrTiO_3$ film capacitor was explored to improve the energy density. With Au and Al being deposited on $SrTiO_3$ thin films as top electrode, the breakdown processes were investigated by a real-time optical microscope system. A high electric field of the electrode edge attributed to edge effect provided the "trigger factor" for the self-repairing behavior. Absorbed water not only provided "mobile phase" for self-repairing process which significantly enhanced breakdown strength but also, and equally important, it supplied additional polarization charges to raise dielectric constant. As a result of the concurrent increase in E_b and ε_r, a higher energy density of 15.7 J/cm^3 is achieved. A leakage current platform was observed in the self-repairing process and the thickness of a new layer Al_2O_3 film generated from self-repairing process was estimated according to Ohm's law and breakdown strength. Using relative humidity dependence of breakdown voltage, the maximum breakdown field was explored to realize the optimum self-repairing capability.

Keywords: self-repairing; edge effect; energy density.

1. Introduction

With the development of modern electronic materials, scientists are looking forward to finding the intelligent materials which exhibit self-repairing function. When the material was damaged by thermal, mechanical or other means, self-repairing function enable the material to heal and restore itself to the original set