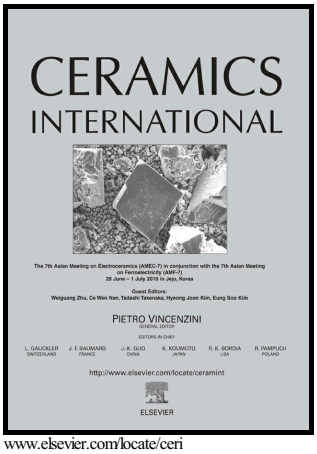

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Yong Peng, Manwen Yao, Xi Yao

PII: S0272-8842(17)32517-8
DOI: https://doi.org/10.1016/j.ceramint.2017.11.060
Reference: CERI16715

To appear in: *Ceramics International*

Received date: 20 September 2017
Revised date: 9 November 2017
Accepted date: 9 November 2017

Cite this article as: Yong Peng, Manwen Yao and Xi Yao, Interfacial origin of enhanced energy density in $SrTiO_3$-based nanocomposite films, *Ceramics International,* https://doi.org/10.1016/j.ceramint.2017.11.060

Interfacial origin of enhanced energy density in $SrTiO_3$-based nanocomposite films

Yong Peng, Manwen Yao*, Xi Yao

Functional Materials Research Laboratory, School of Materials Science and Engineering, Tongji University, 4800, Cao-an Hwy., Shanghai, 201804, China

E-mail address: yaomw@tongji.edu.cn

Abstract: $SrTiO_3$-based films doped with different Al-precursors were prepared by sol-gel methods and the dielectric strengths and leakage currents of the materials were investigated. The best performance was found in $SrTiO_3$ films doped with Al_2O_3 nanoparticles (nano-Al_2O_3). When 5 mol% of nano-Al_2O_3 was added to $SrTiO_3$ films with Al electrodes, the dielectric strength was enhanced to 506.9 MV/m compared with a value of 233.5 MV/m for $SrTiO_3$ films. The energy density of the 5 mol% nano-Al_2O_3 doped $SrTiO_3$ films was 19.3 J/cm^3, which was also far higher than that of the $SrTiO_3$ films (3.2 J/cm^3). These results were attributed to interfacial anodic oxidation reactions, which were experimentally confirmed by cross-sectional transmission electron microscope studies and theoretically modelled based on Faraday's laws. The films with added nano-Al_2O_3 featured many conducting paths at the interfaces between the host phase and the guest nano-Al_2O_3, which promoted ion transport and contributed to the strong anodic oxidation reaction capability of the 5 mol% nano-Al_2O_3 doped $SrTiO_3$ films.

Keywords: Dielectric strength, Leakage current, Energy density, Interfacial effect, Anodic oxidation.