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Abstracts

Local electric field effect on symmetry and ferroelectric property of near morphotropic phase boundary compositions

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The complex behavior of near morphotropic phase boundary ferroelectrics under various local field conditions as a function of temperature is studied by both the dielectric spectrum and the thermal dilatometry. The relationship among the field- and temperature-sensitivity of the dielectric permittivity, as well as the spontaneous and induced strain, is of particular interest for this investigation. Qualitative understanding and preliminary quantitative analysis are shown to be useful in providing guidelines for tailoring the materials properties and for evaluating the scale of field-induced strain in a single crystal relaxor ferroelectric material.

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Growth and electric-properties of silicon-based high-*k* oxide thin films by laser-MBE

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In a metal-oxide-semiconductor field effect transistor (MOSFET), as the scale of the channel length decreases to sub-micron feature size, it requires a corresponding reduction in the gate dielectric thickness to achieve high quality performance. For a conventional SiO_2 gate, when the dielectric scale is less than 20 Å, a high leakage current would be inevitable due to the occurrence of direct tunneling. To solve this problem, high-*k* (dielectric constant) ($k > 3.9$) material could be used to replace the conventional SiO_2. The most commonly studied high-*k* dielectric candidates have been suggested as alternative gate dielectrics such as Y_2O_3, YSZ, CeO_2, $SrTiO_3$ and Al_2O_3 etc., which dielectric constant ranging from 10 to 80, and have been employed mainly due to their maturity in memory capacitor applications. However, there are some problems to apply these dielectrics to the application for ultra large scale integration (ULSI) devices. The one problem is that most of them crystallize during the source/drain activation. The other problem is that the formation of amorphous SiO_2 phase and inter diffusion component at the interface between the dielectrics and Si substrates. The electrical characteristics of the metal-oxide-semiconductor (MOS) structure greatly become poor if there is interfacial layer between the dielectrics and Si substrates. Many efforts have been made to solve the problems, but seldom methods were succeeded.

It is well known that the property of the stability of the thermal and chemical characteristic of the films is very important in order to apply them as a dielectric material as well as a buffer layer in memory devices. $LaAlO_3$ (LAO) has a wide energy band gap ~5 eV, high dielectric constant ~23, and thermal stability up to 2100 °C. Single crystal LAO wafers are widely used as the substrates of the superconducting devices or optical devices, they are also widely used as the buffer layer materials.

In this paper, we report the amorphous LAO thin films grown on Si substrates by laser molecular beam epitaxy (LMBE) without Silica interfacial layer between the LAO films and the Si substrates. The electrical properties of the Au/LAO/Si metal-oxide-semiconductor capacitor were investigated. The results showed that the LAO thin film may be a promising candidate as alternative gate dielectrics.

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Low-loss dielectric ceramics in filled-type tungsten bronze oxides

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