that the as-grown films are highly epitaxial with excellent single crystal quality. The high temperature electrical properties of the films have been systematically investigated with traditional four-probe dc and ac-resistance measurement techniques and by two-probe ac impedance spectroscopy. Activation energies and diffusivities for these materials have been derived from the ac and dc-resistance measurements at different temperatures, or the Arrhenius plot—$\ln(\sigma)$ versus $(1/T)$. For instance, the activation energy of $La_{0.5}Sr_{0.5}CoO_3$ thin films on YSZ was determined to be 1.3 eV. The oxygen diffusivities in nano columnar structures of these materials have been also investigated. Various high temperature transport phenomena have been observed from these systems. The nano domain structures might play a key role in the oxygen conduction in the solid state fuel cell devices. Details will be discussed in the talk.

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Magnetoelectricity of multiferroic composites

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Differently from magnetoelectric (ME) crystal families (e.g. Cr_2O_3 and phosphates) to which the ME effect is intrinsic, multiferroic composites such as ferrite/piezoelectric ceramic composites exhibit extrinsic ME effect which is known as a 'product property' resulting from the interaction between the ferrite and piezoelectric ceramic phases, and the extrinsic ME effect is a '$0 + 0 > 0$ composite effect', since neither phase is magnetoelectric. In this article, based on the expressions derived by using a physics-based Green's function technique, we review the extrinsic ME effect in a few piezoelectric/magnetostrictive composites including laminated and particulate composites.

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Hot spot phenomenon in ceramic rod and its application

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The present authors found a phenomenon that a local area of $LnBa_2Cu_3O_{7-\delta}$ (Ln: rare-earth element) ceramic rod glows with orange when a voltage over a certain value is applied to the rod at room temperature. The glowing area migrates toward the negative electrodes. We named the area hot spot. The rod with the hot spot shows various functional characteristics. After the hot spot appearance, the current through the rod remains constant with increasing voltage, showing a prospective application for a constant current generator without any active component. The current depends on the oxygen partial pressure in the ambient atmosphere, which provides an oxygen sensor without any heating system. The current is sensitive to the gas flow around the hot spot, resulting in a sensitive flowmeter. Under low oxygen partial pressure, the current vibrates in the form of damped sinusoidal oscillation, which can be used as a low-frequency generator. In this presentation, firstly, we show the mechanism of the hot spot appearance from the view point of heat balance in the ceramics. Secondly, the mechanism of the hot spot migration is discussed from ionic conduction. The hot spot is considered to appear in the ceramics with positive temperature coefficient of resistivity (PTCR). New application field may be created from the related researches.

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Preparation and dielectric property of perovskite artificial superlattices

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Barium titanate (BTO)/strontium titanate (STO) artificial superlattices were fabricated by molecular beam epitaxy (MBE) process. Dielectric properties were measured for superlattice films on pure STO substrates using planer interdigital electrodes. Superlattice films were so thin (32 nm) that fine planer electrodes were necessary to reduce the penetration of electric flux into the substrate. Interdigital electrodes with the interdigital width of 5 μm were formed by electron beam lithography. Dielectric permittivity of superlattices was determined from admittance data using en electromagnetic field analysis. It was found that the dielectric permittivity changed with the structure of superlattices and the highest permittivity was obtained for $[(BTO)_{10}/(STO)_{10}]_4$ superlattice from 1 to 110 MHz. The refractive index of the superlattice films was measured with a spectroscopic ellipsometry. The refractive index of the superlattices changed with their structures and those of $[(BTO)_{10}/(STO)_{10}]_4$ superlattices were larger than other superlattices. This indicated that the superlattice structure affected not only on the ionic polarization but also on the electronic structure or chemical bonding nature in the superlattices.

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