Investigation of the synthesis, structures and anionic conductivities of Ln_4GeO_8 and $Ln_4Ga_2O_9$ related compounds

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Solid oxide fuel cells are attracting considerable interest because of the prospect of utilizing their high efficiency and environmentally friendly nature. However, the development of new materials with improved properties is still necessary before the introduction of fuel cells into widespread use will become a reality. In the present systems, the most widely used electrolyte is yttria stabilized zirconia, but its high operational temperature (≥800°C) induces severe restrictions upon the materials that can be used reliably and causes problems of lifetime. Therefore, there is a need for new oxide ion conductors with improved properties.

As part of the efforts to find a suitable alternative to YSZ electrolyte material, we have recently initiated an evaluation of the potentialities of rare-earth oxo-gallates and oxo-germanates. In this presentation, we report a detailed investigation of $Ln_4Ge_{1-x}M_xO_{8-x/2}$ (M = Ga) compounds and the cuspidine type $Ln_4Ga_{2-x}M_xO_{9+x/2}$ (M = Ti, Ge) compounds. A specific attention will be given to a novel synthetic route for obtaining well sintered materials and also to the influence of the substitution of on the anionic conductivity. The highest level of anionic conductivity is observed in the $Ln_4Ge_{1-x}M_xO_{8-x/2}$ system and reaches 2.10^{-3} S/cm for x = 0.1 at 800°C. It is associated with a low activation energy (Ea =0.4 eV above 650°C).