Poster Presentation

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Synthesis, structure and electrochemistry of REBCO as cathode for IT-SOFCs

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Solid Oxide Fuel Cells (SOFCs) are considered an excellent alternative among the different sources of clean energy, especially in the case of static and long-run applications due to its demonstrated efficiency, stability and fuel flexibility. The principle of operation of a fuel cell involves the electrochemical reaction between a fuel and an oxidant in separate compartments to produce an electric current. The reactions take place on the surface of the electrodes, oxygen reduction reaction (ORR) at the cathode and fuel oxidation at the anode, while the circuit is closed by transporting charges through the ceramic electrolyte. Currently, the interest in those devices is focused especially in the so-called Intermediate Temperature Solid Oxide Fuel Cell (IT-SOFC) that operate between 600-800°C which creates the necessity for new materials with higher electrochemical activity in this temperature range. The higher catalytic activities have been reported for materials with ABO3-δ perovskite type structure with oxygen deficiencies (δ> 0) and a cubic or pseudocubic network. The most studied materials present a mixture of alkaline earth and lanthanide cations at A site and 3d transition metal mixtures at B site which ensures sufficient number of oxygen vacancies and mixed-valence B sites making these cathodes mixed ionic-electronic conductors (MIECs). We have already prepared and studied conventional cathodes with unconventional dopants as Cu [1]. Novel materials, however, need to be considered if fast progress wants to be achieved, since modification of traditional materials has proven to be a slow way forward. With this in mind we are in the search of other perovskite phases that show electrical conductivity and oxygen vacancies, able to act as MIECs and also provide good catalytic activity for the ORR. In collaboration with other groups we have already studied La4BaCu5O13-δ and doped variants, with mixed results [2]. Considering the large number and mobility of oxygen vacancies (even at room temperature) and high electric conductivity of traditional high TC superconductor YBa2Cu3O7 [3] we have prepared and tested it as a cathode for IT-SOFCs with Ce0.9Gd0.1O1.95 (GDC) electrolyte obtaining ARS values on symmetrical cells of 0.14 Ω cm2 at 800°C. However YBCO shows an orthorhombic to tetragonal (O/T) phase transition associated with a strong change in oxygen content and mobility (see figure) that may be a problem for IT-SOFC mechanical stability. Motivated by these promising results and the reported changes in the O/T phase transition with RE, an extended study on REBa2Cu3O6+δ (REBCO, RE=Rare Earth) family, obtained through a similar combustion reaction path and characterized by synchrotron X-ray Powder Diffraction (S-XRD) is presented. We have found that the larger the RE cation reduces the O/T phase transition temperature, being eliminated in the RT-900°C range for RE=Nd, making it a more promising IT-SOFC cathode material in process of being characterized.

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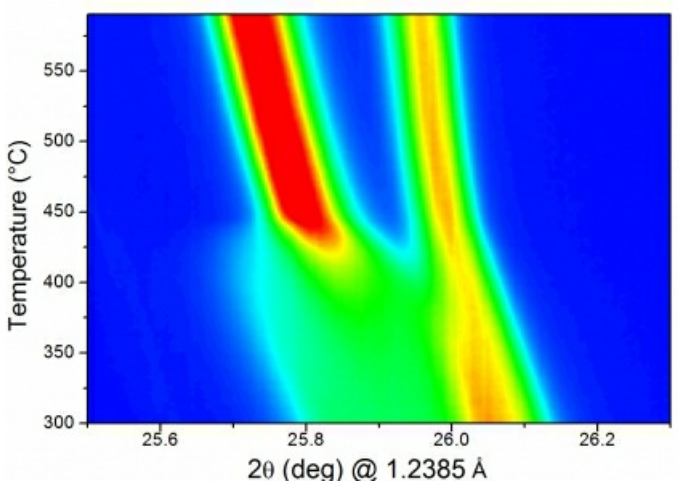

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