Synthesis and characterization of $Pb_2Ru_2O_{6.5}$ pyrochlore for electrodic application in ESB based electrolyte symmetric cells

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Ruthenium based pyroclhores are known for their electrical properties (1, 2) and remarkable performances of this material have been investigated in cathalysis (3) and in electrochemical application (4).
Lead ruthenate ($Pb_2Ru_2O_{6.5}$), particularly , has been evaluated as possible candidate for SOFCs' cathodic applications (5,6) because of its low polarization in the oxygen reduction process (6).
In this work, pure composition of $Pb_2Ru_2O_{6.5}$ was obtained by two methods: citrate amorphous and a new co-precipitation method. Powders phase and morphology were studied, respectively, by XRD (fig. 1) and FE-SEM. The co-precipitation showed better result in terms of purity and morphology.
Ultra-fine powders (50 – 100 nm) were obtained at low temperature (500 – 700 °C) by the new method and the electrical properties of the ceramic were confirmed by 4-probe measurements in air (fig. 2). The nanometric pyroclhore powders were used to fabricate porous electrodes on $(Er_2O_3)_{0.2}(Bi_2O_3)_{0.8}$ (ESB) electrolyte. Reactivity between $Pb_2Ru_2O_{6.5}$ and ESB was studies by XRD, EDS and FE-SEM while electrochemical features of the $Pb_2Ru_2O_{6.5}$/ESB/$Pb_2Ru_2O_{6.5}$ symmetric cell were performed by electrochemical impedance spectroscopy (EIS) at different temperatures in air. Low and intermediate temperature (200 °C – 550 °C) allowed to separate and study each cell component contribution while electrodic polarization of the cell in air was studied at higher temperature (600 °C – 750 °C) (fig. 3). EBS electrolyte, lead ruthenate electrodes and their interface were also investigated for different sintering temperatures (700 °C – 900 °C) of the electrodes onto the electrolyte. The pyochlore electrodes properties were compared with further ESB based symmetric cells performances.

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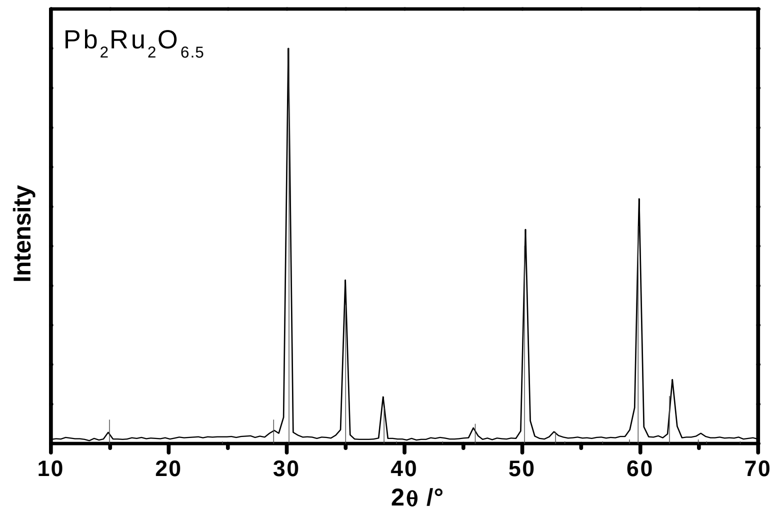

Fig. 1. XRD pattern of the pyroclhore powder calcined at 800 °C obtained by amorphous citrate method.

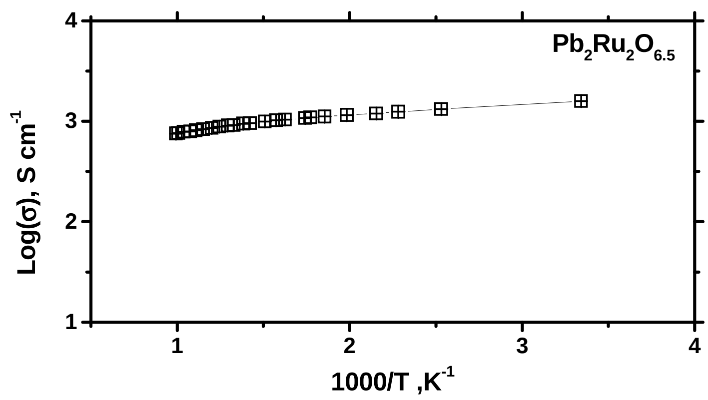

Fig. 2. Four-probe test in air of the pyroclhore sintered at 875 °C for 15 h.

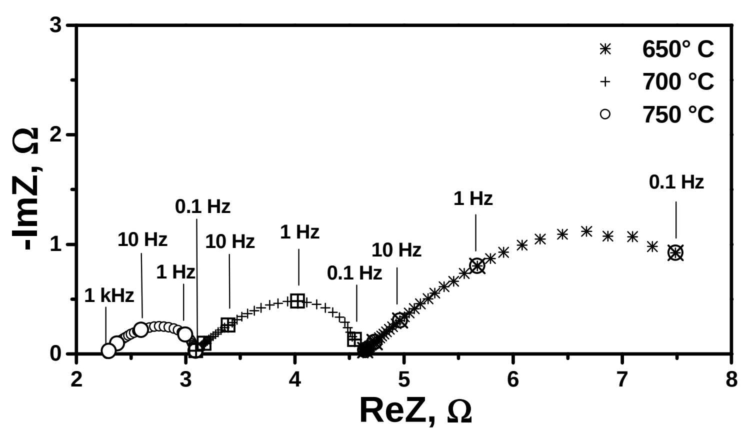

Fig. 3. Typical complex impedance diagrams plotted for $Pb_2Ru_2O_{6.5}$/ESB/ $Pb_2Ru_2O_{6.5}$ symmetric cell in air at higher temperatures.