Elaboration of sodium titanates for potentiometric CO_2 sensors

S. Baliteau[a], A-L. Sauvet[b], C. Lopez[a]* and P. Fabry[a]

[a]*LEPMI, INPG-UJF-CNRS, 1130 rue de la piscine, 38 402 Saint Martin d'Hères Cedex*

[b]*CEA Le Ripault, BP 16, 37260 Monts, France*

Tel :33 4 76 82 65 73, email : christian.lopez@lepmi.inpg.fr

Abstract

A ceramic approach is studied for all solid state sensor devices in the case of a potentiometric way based on sodium conductor electrolyte like NASICON. In our open system, the reference should be sensitive to oxygen pressure. Thus, this work presents the elaboration and the characterization of a two phase materials based on $Na_2Ti_3O_7$ -$Na_2Ti_6O_{13}$. These materials were synthesized by sol-gel process, characterized by x-rays diffraction, electronic scan microscopy, thermogravimetry analysis (TGA), differential thermal analysis (DTA) and dilatometry. A heat treatement inferior to 1100°C gives a pure phase of $Na_2Ti_3O_7$. The DTA shows a peak at 680°C corresponding to $Na_2Ti_3O_7$. Above this temperature, $Na_2Ti_6O_{13}$ appears from the decomposition of $Na_2Ti_3O_7$. A heat treatement at 700°C is needed to prepare a pure phase of $Na_2Ti_6O_{13}$. Above this one, a secondary phase of TiO_2 (rutile) appears and it is confirmed by DTA.

Conductivity measurements were carried out by electrochimical impedance spectroscopy (EIS) on pellets of pure $Na_2Ti_3O_7$ and $Na_2Ti_6O_{13}/TiO_2$ according to the temperature and the oxygen pressure. As a result, in all experimental conditions, the conductivity of $Na_2Ti_3O_7$ was higher than the $Na_2Ti_6O_{13}/TiO_2$ one. An influence of the holding time during the shrinkage occurs on the conductivity of the two materials: the conductivity of $Na_2Ti_3O_7$ decreases whereas the $Na_2Ti_6O_{13}$ one increases with accumulating TiO_2 phase.

Keywords: Sensors, CO_2, Nasicon, sodium titanates, conductivity