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Synthesis and ionic conduction of lanthanum-neodymium doped strontium phosphosilicate apatite

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The characterization and ionic conductivity of phosphosilicate apatites obtained by a coupled substitution of the divalent cation by a trivalent lanthanide or a tetravalent actinide ion and the trivalent groupment PO4 by a tetravalent SiO4 groupment in the general formula Me(XO4)6Y2 (Me: divalent cation; XO4: anionic groupment and Y: monovalent anion). Strontium phosphosilicate apatite doped with lanthanum and neodymium and whose chemical formula Sr8La2-xNdx(PO4)4(SiO4)2F2 with $0 \leq x \leq 2$ were physico-chemically investigated. The materials were prepared via conventional solid state reactions. The analysis and characterization of the synthesized powders were conducted by means of several techniques. The ionic conductivity σ of the samples was measured via a complex impedance spectroscopy. The results showed that the double substitution of lanthanum-neodymium in strontium phosphosilicate fluorapatite was effective and well crystallized single-phase apatites were successively obtained. The molar ratio was of about 1.67 verifying the stoichiometry character of the powders. The a and c lattice parameters obtained from a structural refinement by the Rietveld method were found in decrease if the Nd content (x) rose. The 31P NMR (MAS) exhibited a single peak and the FTIR spectroscopy revealed the characteristic bands of phosphosilicated fluorapatite. The neodymium-lanthanum substitution was total according to the small size differences of the two cations. The measured ionic conductivity σ of the samples was found to depend simultaneously on the Nd content and more intensively on the heating temperature, the maximum was 1.73×10^{-6} $S.cm^{-1}$ obtained at 780°C for x=2.