1D/2D NMR analysis of Al2O3-NaPO3 glasses

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Abstract

Phosphate based glasses have attracted much attention during the last decades. Thanks to their good properties (low Tg, high TEC...), this type of glass has been used in many applications (laser glasses, low temperature sealing glasses, host matrix...). All these applications require glasses with acceptable stability and this parameter can be significantly improved by the addition of trivalent oxides (Al2O3, Fe2O3, B2O3). The impacts of these additions on the materials structure and properties need to be perfectly understood and many papers were devoted to this topic. In this presentation, we will show how the insertion of Al atoms in the sodium metaphosphate (NaPO3) glass was studied by 1D/2D solid state NMR. The local order and its evolution were first analysed by 1D 23Na, 27Al and 31P MAS-NMR experiments. Then the presence of P-O-Al bonds was investigated by the 27Al(31P) D-HMQC NMR technique. The set of results was used to decompose the 1D 31P NMR spectra and to determine the overall Qnm phosphate speciation (n and m being the number of attached P and Al). The results show that the Q2 units of the NaPO3 structure are converted into Q11Al and Q12Al species at low Al2O3 contents and to Q02 and Q03 species at higher Al2O3 amounts. The structural model deduced from our experiments was used to understand the three-domains evolution of the Tg parameters.

Keywords: NMR, phosphate glasses

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