Nanocomposites and nanomaterials

Synthesis and investigation of electrical properties of $Li_{1,3}Al_{0,3}Ti_{1,7}(PO_4)_3$ thick films with NASICON structure

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A lithium-ion battery containing solid electrolyte compared with liquid electrolyte is safer and more resistant to shock and vibration, is characterized by a large temperature window as well as provides a better cycle. Among the known lithium ion solid electrolytes, $Li_{1,3}Al_{0,3}Ti_{1,7}(PO_4)_3$ (LATP) with NASICON structure attracts great attention as it has high ionic conductivity in Li^+ ions at room temperature ($\sigma \sim 10^{-4}$ Sm · cm^{-1}) [1]. These materials are widely studied in the form of bulk samples, while there is little information on the synthesis and study of their electrical properties as thick films.

Therefore, the aim of this work is to develop techniques and get LATP thick films by «type-casting» method. We prepared film forming suspension based on the previously synthesized nanoparticles and organic reagents such as: acetylacetone and isopropanol (solvents), polymethylmethacrylate (a binder), dibutyl phthalate (a plasticizer) dybutylfosfatom, hallotanninom (dispersants). We also established their optimal mass ratio. However, the obtained films were characterized by a relatively high porosity. The influence of lamination and different modes of heat treatment to increase the density of LATP films was investigated.

Based on research data lamination can significantly increase the density of LATP thick films. It is found that the two-stage heat treatment mode where the first stage of the heating rate was 20 °C /h, and the second - 180 °C/h is optimal. It is also established that the conductivity of LATP thick films after lamination is σ = 1,6 · 10-4 S/cm at room temperature, which is comparable with the conductivity of bulk ceramics $Li_{1,3}Al_{0,3}Ti_{1,7}(PO_4)_3$ with NASICON structure.

1. *Arbi K., Rojo J.M., Sanz J.* // J. Eur. Ceram. Soc. -2007. -**27-** P.4215-4218.