NEW GREEN DIELECTRICS RELATED TO CALCIUM TITANATE: SYNTHESIS AND CHARACTERIZATIONS

L. TAÏBI-BENZIADA[1],* Y. KHEREDDINE[2], T. KERDJA[2] AND K. HENDA[2]

[1]*Faculty of Chemistry, USTHB, PO Box 32 El-Alia, Bab-Ezzouar 16024, Algiers, Algeria*
[2]*Centre de Développement des Technologies Avancées (CDTA), Baba-Hassan, Algeria*
E-mail: lbenziada@usthb.dz

Keywords: Lead-free Dielectrics, Sintering, Phase Transitions

Calcium titanate oxide $CaTiO_3$ (CTO) belongs to the novel engineering ceramics used in microwave technologies and is one of the post-PZT materials [1-4]. CTO and its solid solutions exhibit a lot of electronic and structural properties that make them multifunctional. Therefore, CTO-based materials attracted more and more researchers. The main purpose of the present work is the preparation of new lead-free dielectrics by solid state reaction between two perovskites: $CaTiO_3$ and $KMgF_3$.

Calcium titanate and potassium magnesium fluoride powders were previously synthesized respectively at 850 °C and 700 °C. Several chemical compositions 1-x $CaTiO_3$ + x $KMgF_3$ were then prepared and dry-milled. The mixtures were pressed into pellets and sintered in free air at 900 °C for 2 h. The obtained ceramics were investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM), differential scanning calorimetry (DSC), thermogravimetric analyses (TGA, DTGA) and dielectric measurements (DE).

The XRD study showed the formation of a fluorinated perovskite solid solution with formula $Ca_{1-x}K_xTi_{1-x}Li_xO_{3-3x}F_{3x}$ (CTOF) in the initial composition range $0 \leq x \leq 0.20$. The diffraction peaks of CTOF samples were indexed in an orthorhombic lattice and no significant change was observed in the unit cell parameters with increasing $KMgF_3$ amount. On the other hand, the addition of $KMgF_3$ to CTO allowed the ceramic's densification at low temperature. The shrinkage increased from 1.9 % to 9.5 % and the grain's size of the various ceramics was in the range 0.5 – 5 µm. Several thermal phenomena were detected by DSC and DE. No weight loss and no peak were depicted on the TGA and the DTGA curves over all the temperature range investigated; therefore, the phenomena observed by DSC and DE could be ascribed to phase transitions.

References

[1]. L. Taïbi-Benziada, A. Mezroua, R. Von Der Mühll. $CaTiO_3$ Related Materials for Resonators, *Ceramics-Silikáty*, 2004, 48, 180.
[2]. H.K. Shin, H. Shin, S.Y. Cho, K.S. Hong. Phase Evolution and Dielectric Properties of $MgTiO_3$-$CaTiO_3$-Based Ceramic Sintered with Lithium Borosilicate Glass for Application to Low-Temperature Co-Fired Ceramics, *J. Am. Ceram. Soc.*, 2005, 88, 2461.
[3]. R. Freer, F. Azough. Microstructural Engineering of Microwave Dielectric Ceramics, *J. Eur. Ceram. Soc.*, 2008, 8, 1433.
[4]. X. Wang, L. Zhang, H. Liu, J. Zhai, X. Yao. Dielectric Nonlinear Properties of $BaTiO_3$-$CaTiO_3$-$SrTiO_3$ Ceramics near the Solubility Limit, *Materials Chemistry and Physics*, 2008, 112, 675.