11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

The effect of Pb on the growth mechanism of $CaTiO_3$ mesocrystals by template-free

S. A. Eliziário[(1)*], C. S. Xavier[(1)], T. Sequinel[(1)], E. Longo[(1)] and J. A. Varela[(2)]

(1) LIEC, Physical- Chemistry Departament, Institute of Chemistry, São Paulo State University, sayonaraea@yahoo.com.br.
* Corresponding author.

Abstract – Large-scale 3D micro-cubes mesocrystals composed of plates-aggregated were synthesized using microwave-assisted hydrothermal method at reduced of processing time and low temperature reaction, without template agent. X-ray diffraction (XRD), Raman spectrum, room temperature photoluminescence (PL) and scanning electron microscopy (FEG-SEM) are used to understanding the growth mecanism of PCT mesocrystals. The effect of different compositions of $Pb_xCa_{1-x}TiO_3$ on the luminescent properties of the powders was investigated in this study.

Recently, the fabrication of hierarchical and complex nano- and microstructures and controllable synthesis of highly ordered superstructures these materials with distinctive shapes and sizes has attracted increasing attention in searching for materials with novel properties and tailorable functions. Understanding the crystallization process offers opportunities in seeking exciting new properties of materials, and is helpful for making functional nanodevices. [1, 2] Mesocrystals should receive considerable attention in the future not only because of their importance in understanding the concept of self-assembly and the new formation mechanism of single crystals with nanoparticle building blocks but also for their great potential applications. $(Pb,Ca)TiO_3$ is a ferroelectric material with the perovskite structure and has emerged as a material of choice for ferroelectric memories, pyroelectric devices and also for dynamic memories and tunable devices. This material exhibit properties, which are most dependent on the method of synthesis, structure and crystalline phases. In this work, PCT and CT mesocrystals were prepared initially by sol-gel method and then processed by microwave-assisted hydrothermal method (HTMW) at 140°C. We have studied the role of Pb cation on the order-disorder structural, mesocrystals morphology and PL phenomenon. The perovskites were characterized using X-ray diffraction (XRD), field emission scanning electron (FE-SEM), PL measurements, UV–vis and Raman spectroscopy. X-ray diffraction confirms the crystalline nature of samples orthorhombic perovskite $CaTiO_3$ with Pbnm symmetry. The product formed shows peaks that consistent with literature and are indexed by ICDS (Inorganic Crystal Structure Database) card No. 74-214. SEM images showed that the sample consists a lot of micro-cubes-shaped mesocrystals and it is possible to gain a general view of the mesocrystals formation pathways by understanding the synthesis process. PL results are controlled by oxygen vacancies in the PCT crystal, and the oxygen vacancies can induce the formation of new energy levels in the band gap. The presence of these inherent defects strongly influences many light-induced and electronic properties of disordered structure.

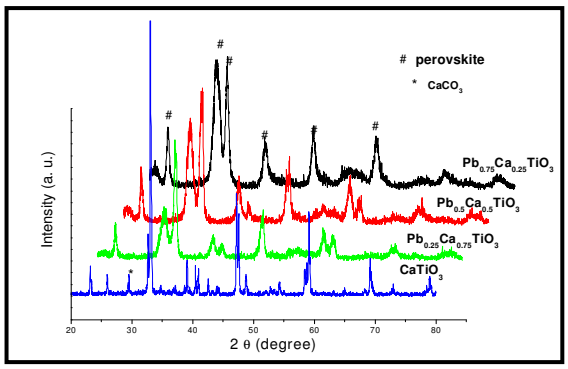

Figure 1: X-ray diffraction of $PB_xCa_{1-x}TiO_3$ nanopowders at 140ºC for 1 h, synthetized by HTMW.

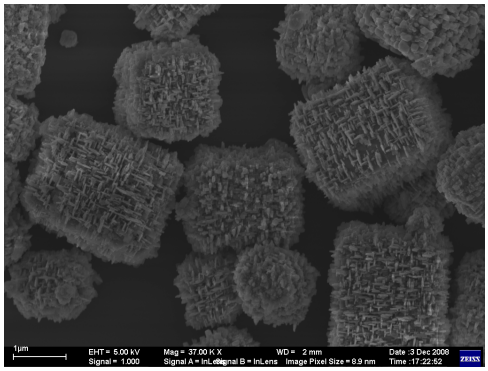

Figure 2: FEG-SEM micrographs of $PB_{0.5}Ca_{0.5}TiO_3$ nanopowders at 140ºC for 1 h, synthetized by HTMW.

References

[1] J. Fang, B. Ding, X. Song . Appl. Phys. Lett., v. 91 (2007) 083108.
[2] D. S. L. Pontes et al. J. Phys. Chem. Solids v. 69 (2008) 1951.
[3] F. M. Pontes et al. Appl. Phys. Lett., v. 78 (2004) 349.