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Synthesis and Characterization of $Ca_2Al_2SiO_7$ co-doped with Ce^{3+} and Mn^{2+} via proteic sol-gel method

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Abstract – The present work is developed in the department of Physics of the Federal University of Sergipe and the objective is produce ceramic nanopowder of long phosphorescence for industrial applications through the proteic sol-gel method.

Nanostructured materials are focus of several researches due to the great possibility of scientific and technological applications. Aluminates, silicates and aluminosilicates can exhibit phosphorescence emission during longer time intervals than materials already established as the zinc sulfide [1]. Besides, it is possible to produce them through the proteic sol-gel method, which is an economical and environmental viable alternative to the traditional sol-gel process with alchoxides [2]. The synthesis and characterization of calcium aluminosilicates ($Ca_2Al_2SiO_7$: Ce^{3+}, Mn^{2+}) nanopowders is investigated in this work, aiming industrial application in ceramic coatings.

The ceramic nanopowders of pure and Ce^{2+} and Mn^{2+} co-doped $Ca_2Al_2SiO_7$ samples are obtained through the proteic sol-gel process. In that process, SiO_2, chlorides or nitrates of Calcium and Aluminum and the dopant are mixed in coconut water (*Cocos nucifera*) forming a sol. After some time, a gel is developed. The material is dried at 100ºC for 24h, resulting in a xerogel which is further homogenized in agate mortar and calcined at high temperatures.

The structural characterization of that material was done via Thermal Analysis and powder X-ray Diffraction. The evolution and morphologic characterization of the nanoparticles were analyzed via Optical, Atomic Force and Scanning Electron Microscopy. The luminescent properties, which are of fundamental importance to the applicability of the materials, were done with Optical Absorption, Spectrofluorimetry and Radioluminescence techniques.

Analysis carried out in DTA (fig. 1) and XRD (fig. 2) indicated that an exothermic peak around 950 °C is associated with formation of $Ca_2Al_2SiO_7$. XRD of samples calcined at 1200 °C shows the presence of other crystalline phases, such as $CaAl_2O_4$ and $CaAl_2Si_2O_8$. The higher temperatures exothermic peaks in DTA curves are associated the formation of the additional phases. The optical absorption of $Ca_2Al_2SiO_7$: Ce^{3+}, Mn^{2+} is shown in fig. 3. The main peaks in the visible range are due to the transitions of the d4 electronic configuration of Mn^{2+}. In the UV region, on the other range, the UV peaks are superimposed to the Ce^{3+} 4f transitions in the 300-350 nm region. (Work partially supported by CNPq and FINEP. PJRM acknowledge the CNEN for the Dr grant).

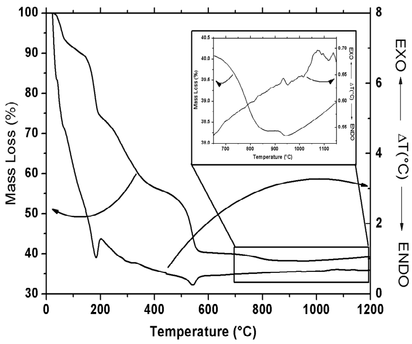

Fig. 1: DTA of xerogel

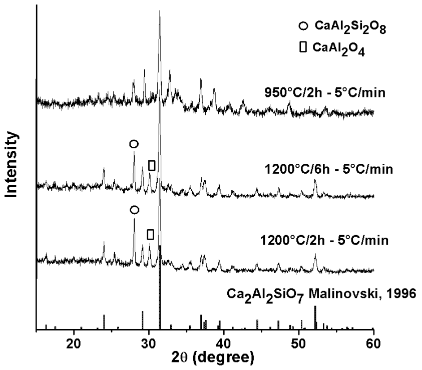

Fig. 2: XRD of $Ca_2Al_2SiO_7$ powders calcined in different temperatures

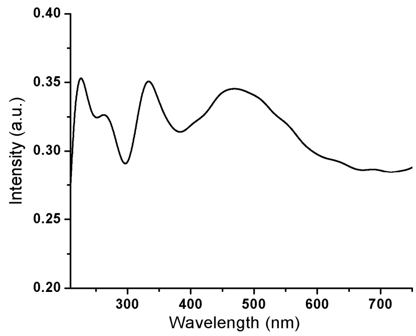

Fig. 3: Optical Absorption of $Ca_2Al_2SiO_7$: Ce^{3+}, Mn^{2+} powders.

References

[1] L. Jiang, C. Chang, D. Mao, "Luminescent properties of $CaMgSi_2O_6$ and $Ca_2MgSi_2O_7$ phosphors activated by Eu^{2+}, Dy^{3+} and Nd^{3+}", Journal of Alloys and Compounds, 360, 193-197 (2003).
[2] M. Macêdo, "Processo de Fabricação de Camadas Finas Óxidas Utilizando a Água de Coco Processada (ACP)", INPI 9804719-1.