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Microwave Hydrothermal Synthesis and Optical Properties of HfO_2 rice-like.

S. A. Eliziário[(1)*], C. S. Xavier[(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 – HfO_2 nanostructures were successfully prepared using microwave hydrothermal synthesis (HTMW) at reduced of processing time and low temperature reaction. The powder was characterized by X-ray diffraction (XRD), room temperature photoluminescence (PL), scanning electron microscopy (SEM-FEG) and High Resolution transmission electron microscopy (HRTEM). FEG-SEM and TEM micrographs revealed rice-likes morphology. The involved states in the emission photoluminescence process are originated of a small amount of V_o^x and the intrinsic distortion between the O–Hf–O bonds of $[HfO_6]$ clusters.

Transition metal oxides, such as hafnium oxide (HfO_2), have attracted significant attention because of their potential technological applications [1]. The hafnium oxide is an interesting material that can be used as glass-ceramics for planar waveguide, phosphors materials, dielectric materials in optical devices, ceramic, refractory materials, super hard materials, and catalysts and as components in gas sensors and fuel cell electrolytes, due to its thermal stability, high hardness, high permittivity high refractive index and large band gap [2, 3]. It is also one of the most promising high-k dielectric considered suitable candidates for replacing the gate dielectrics in field effect transistors and dynamic random access memories. In this work, HfO_2 was prepared by microwave-assisted hydrothermal method (HTMW) at 140°C for 60 min. We have studied the role of order-disorder with time course of the reaction corroborating of morphology in the PL phenomenon. The nanoparticles were synthesized at reduced of processing time and low temperature reaction by microwave-assisted method under hydrothermal conditions. The sample present monoclinic phase without any impurity phases confirmed the crystalline nature of sample with P21/c symmetry. FEG-SEM observation indicates that the sample consist a lot of aggregates nanoparticles with rice-like morphology. Strong photoluminescence (PL) green emission and small orange emission band are observed and controlled by structure and the degree of order-disorder of material. The involved states in the emission photoluminescence process are originated of a small amount of V^o_x and intrinsic distortion between O–Hf–O bonds of $[HfO_6]$ clusters.

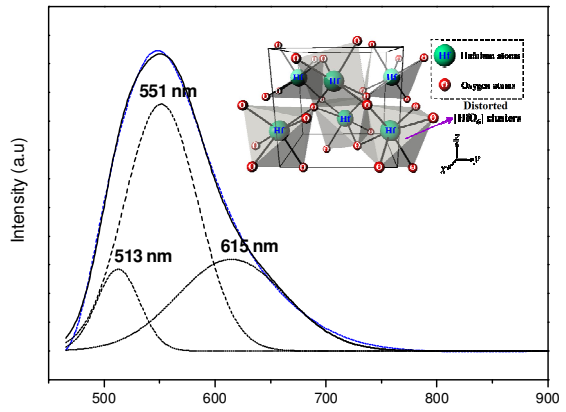

Figure 1: Room Temperature Photoluminescence of HfO_2 nanostructures synthesized at 140 °C for 60 min, synthetized by HTMW.

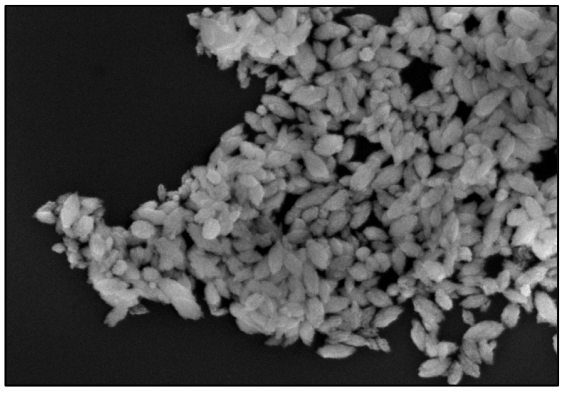

Figure 2: FEG-SEM images of HfO_2 rice-like nanocrystals synthesized at 140 °C for 60 min by HTMW process.

References

[1] J. Tang, J. Fabbri, R. D. Robinson, Y. Zhu, I. P. Herman, M. L. Steigerwald, L. E. Brus, Chem. Mater. 16 (2004) 1336.
[2] G. Stefanic, S. Music, K. Molcanov, J. Alloys Compd. 387 (2005) 300.
[3] L. Minati1, G. Speranza, V. Micheli, M. Ferrari, Y. Jestin, J. Phys. D: Appl. Phys. 42 (2009) 015408