SYNTHESIS OF THIN FILMS NANOSTRUCTURED OF HfO$_2$ DEPOSITED BY THE ULTRASONIC PYROLYTIC SPRAY TECHNIQUE A METAL-ORGANIC SOURCE.

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In this work it is reported the study of thin films of hafnium oxide (HfO$_2$) deposited on crystalline silicon wafers by using the ultrasonic pyrolytic spray technique. The synthesis of the films was made using hafnium acetylacetonate Hf (acac) dissolved in dimethylformamide (N, N-DMF) as hafnium source material. The films obtained were not subjected to subsequent thermal treatments. The deposits were made by varying the substrate temperature 400 and up to 550 °C in steps of 50 °C, and with three different deposit conditions:

1. A first series was made with Hf (acac) dissolved in N, N-DMF.
2. A second series in which during the deposit with the solution of Hf (acac) in N, N-DMF a parallel water spray flow was added.
3. A third series consisted of depositing the films with Hf (acac) dissolved in N, N-DMF adding Trimethyl Silyl Azide (TSA), to the solution of Hf (acac) in N, N-DMF.

Optical characterization was considered like ellipsometry and infrared spectroscopy. For the structural part, the films were characterized by atomic force microscopy (MFA), scanning electron microscopy (SEM), X-ray scattering spectroscopy and X-ray diffraction. Finally, for the electrical part, measurements of current and capacitance against voltage were considered in MOS (Metal-Oxide-Semiconductor) structures conformed with deposited hafnium oxide films. It was found that HfO$_2$ films synthesized by the pyrolytic spray technique have properties that are close to, and even better than, those obtained with other more sophisticated techniques such as ALD, CVD, Sputtering, among others. HfO$_2$ films with better optical, electrical and structural characteristics are those made with the assistance of a water spray stream. Films obtained with the addition of TSA resulted in a dielectric constant close to 14 and RMS roughness of the order of 9 Å. The HfO$_2$ films deposited at 450 °C and with the addition of TSA resulted with the best characteristics.

**Keywords:** nanostructured films, HfO$_2$, CVD Process

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