



Contribution ID: 160

Type: POSTER

PAC study of the Si-HfO₂ system subjected to high energy ball milling

Text

Please specify whether you would prefer an oral or poster contribution.

poster contribution

Summary

The nanotechnological interest in reducing the dimensions of Si complementary metal-oxide-semiconductor devices has led to a need of replacing the SiO₂ gate insulator with high-k dielectric oxides. Among many candidates, HfO₂ and its alloys with SiO₂ have attracted the attention due to their high permittivity and thermodynamic stability concerning solid-state reactions with Si substrate. This fact makes the study of the solid-state reactions between Si and HfO₂ of main interest. The Perturbed Angular Correlations (PAC) method is a powerful tool for the determination of electric field gradients at atomic sites in solids. In this way, it is possible to characterize different compounds and phases.

The aim of this article is to characterize high-energy ball milled equimolar mixture of HfO₂ and crystalline silicon powder by PAC technique complemented with X-ray diffraction analysis. In order to better analyze the results of the milling treatments, pure hafnium oxide was milled in the same conditions and measured subsequently.

PAC results from pure hafnium oxide revealed that the well-known monoclinic phase of HfO₂ is strongly disrupted with 2 hours of high-energy ball milling. A new hyperfine interaction, rather asymmetric, must be proposed to give account of the experimental results. The damage does not increase so much as the milling treatment progresses.

The structure of m-HfO₂ seems to be less perturbed in the milled mixtures HfO₂-Si if compared with the same milling times in pure HfO₂. The same new interaction observed in milled HfO₂, but more asymmetric and distributed, must be considered to give account of the experimental results. The results are compared with previous PAC studies on milled HfO₂-SiO₂ [1].

References

[1] C.Y. Chain et al., Journal of Alloys and Compounds 495, 527 (2010)

Primary author: CHAIN, Cecilia Y. (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, La Plata, Argentina)

Co-authors: RODRIGUEZ TORRES, Claudia (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CONICET, Argentina); Dr MARTINEZ, Jorge L. (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CICPBA, Argentina); Dr DAMONTE, Laura C. (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CONICET, Argentina); Dr FERRARI, Sergio (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CONICET, Argentina)

Presenter: CHAIN, Cecilia Y. (Departamento de Física, IFLP, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, La Plata, Argentina)

Track Classification: Semiconductors, Metals and Insulators