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Development of alternative XRD patterns evaluation methods and their applications for crystalline structure evaluations of ferroelectric $\text{PbZr}_{0.53}\text{Ti}_{0.47}\text{O}_3$ doped with La (1%) ceramics samples under ^{60}Co gamma irradiation

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In previous researches, it has been identified the presence of tetragonal and rhombohedral crystalline phases in ferroelectric ceramic samples of $\text{PbZr}_{0.53}\text{Ti}_{0.47}\text{O}_3$ doped with La (1%) (PLZT) irradiated with ^{60}Co gamma rays, showing their corresponding XRD patterns not conclusive evidences of phase transformations between both phases assisted by gamma irradiation.

The present work concerns with the evaluation of the gamma radiation damage of the irradiated PLZT samples, taking into the account the depleted atom displacement threshold energies due to the presence of point defects in the studied ceramic samples, as has been reported in [1].

It has been crystallographic evaluated, also, XRD reflexions of the non-irradiated PLZT samples, as well as of the irradiated ones by using new research tools of extrinsic and intrinsic nature [2], which are introduced in the present work, according their dependence or not of the choice of a particular crystalline vector basis.

In particular, in the case of the extrinsic methods, it has been established for cubic, tetragonal, orthorhombic and rhombohedral crystalline structures, an important property of the mean square value of the inverse of the interplanar distances taken over those reflexions owing the same value of the sum of square of their Miller Indexes. It results that the former one is proportional to the value of the sum the square Miller Indexes.

On the other hand, new intrinsic evaluation methods were introduced, like the density of reflexion lines and the differences between successive values of the inverse of the interplanar distances.

It results, that all studied PLZT samples (non- gamma irradiated and irradiated ones) comprise two crystalline phases (with tetragonal and rhombohedral structures), where the application of the intrinsic and extrinsic developed methods showed drastic qualitative and quantitative difference among the non-irradiated simple on regard to the irradiated one. The irradiated PLZT XRD patterns showed the presence of two phases with tetragonal and rhombohedral crystalline structures close to the corresponding single-phase reference systems, which are tending to a pseudo -cubic symmetry.

1. E. González, et al. NIM A 865 (2016) 144-147.
2. Eduardo L Mendoza Caballero. BsC. Thesis, InSTEC, Julio/2017.

Primary authors: MENDOZA CABALLERO, E. L. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); RODRÍGUEZ RODRÍGUEZ, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); DURRUTÍ RODRÍGUEZ, M. D. (Institute of Cybernetics, Mathematics and Physics, ICIMAF, Cuba.)

Presenters: MENDOZA CABALLERO, E. L. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

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