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XDR and UV-Vis-NIR spectroscopy characterization of gamma ray irradiated and non-irradiated quartz nanoparticles to be used in solar cells encapsulament

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Abstract - The improvements on photovoltaic systems, such as production costs reduction and increasing of conversion efficiency depends on solutions that involve technological innovation processes, such as selective surface devices development. The importance and benefits of uniformly spread nanoparticles is demonstrated in industrial applications. Quartz nanoparticles of are often used to make thin films substrates, electrical insulation, thermal insulation and moisture sensors, where they act differently [1]. This paper proposes a progressive compressing milling development and characterization of gamma rays irradiated quartz nanoparticles to be used as additive in solar cells polymeric encapsulating films. These particles have the characteristic of ultraviolet radiation absorption [2] which is known to promote the photodegradation these polymeric encapsulators, leading to solar module conversion efficiency failures [1]. The particles were produced using a planetary ball mill with specific accessories. The quartz particles were characterized by optical emission spectroscopy in plasma and X-ray diffraction for size distribution, lattice distortions, applied pressure measurements and contamination analysis. UV-vis-NIR spectroscopy was carried out for optical behavior characterization. The results showed a similar optical behavior of irradiated and non irradiated quartz particles, with high absorption values in the ultraviolet region, when reduced in size (Figure 1). These absorption values differ in the visible and near infrared region, with the largest light transmission values, at this region, being characteristic of irradiated quartz particles. XRD results showed nanoparticles of 42.25nm with lattice parameters distortion ratio c/a = 1.100 to a 47.84MPa applied pressure (Table 1). They also showed a non significant α-Al_2O_3 (corundum) contamination from milling accessories (Figure 2) and an applied pressure considerably less than 2.82GPa, which is a literature related pressure to obtain the same lattice distortion ratio [3]. This means that there is a great energy saving in this quartz nanoparticles production process. Then, the results also allowed concluding that progressive compression grinding process is effective in quartz nanoparticles production.

Table 1: Correlation of milling time, applied pressure, quartz lattice distortion and particle size

Milling time (h)	D_m	Pressure (Mpa)	*c/a*	Naturre
0	170,65μm	0	1,0998	IRQ*
20	6,13μm	47,84295	1,1000	IRQ
40	46,26nm	47,84295	1,1000	IRQ

*gamma irradiated quartz

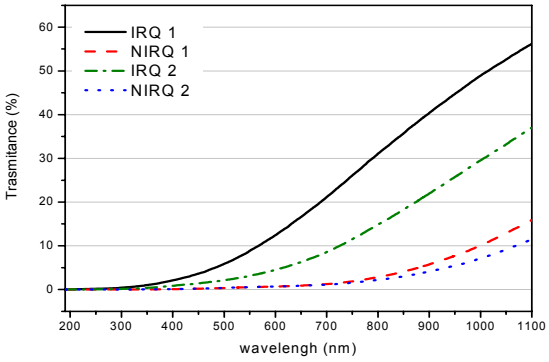

Figure 1: UV-vis-NIR spectra for irradiated (IRQ) and non irradiated (NIRQ) quartz.

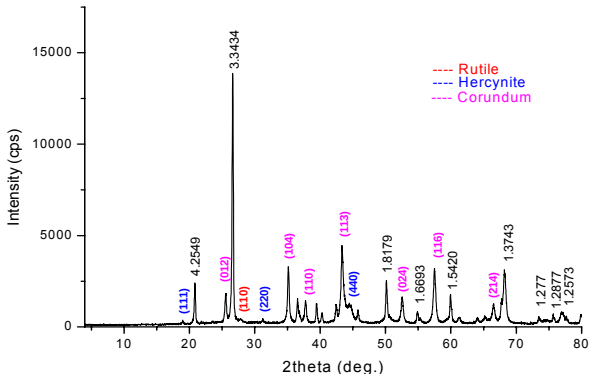

Figure 2: X ray diffraction patterns to 40 hours milled quartz. No significant difference was found in comparison to the non milled quartz diffraction patterns.

References

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