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Synthesis and Characterization of Mg Obtained by Mechanical Alloying and Doped with Al_2O_3 and Y_2O_3

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For several years mechanical alloying has been a well-known process in metallurgy; however, today, mechanical alloys of different metal powders are subjected to repeated mechanical deformations in a powder mill [1]. The balance between cold welding and fracturing leads to the formation of metal compounds in the early stages of grinding and the development of a homogeneous alloy after longer processing. It has recently been found that the amorphous alloy may be produced by mechanical alloying from crystalline elemental powders. Mechanical grinding therefore has on other methods the obtaining of powder, nanocrystalline materials in solid state, thus eliminating the limitations associated with melting points and relative solubilities [2]. It allows the synthesis of new alloys with an initial mixture of high and low melting temperature elements [3], and the synthesis of alloys or composites with highly dispersed components, far from their state of thermal equilibrium.

In the present work, a high-energy mill is used to process magnesium powders and their physical-chemical characteristics are analyzed.

The $Mg_{(1-X)}(Al_2O_3)_X$ and $Mg_{(1-X)}(Y_2O_3)_X$ systems. These compounds were subjected to the same conditions of high energy mechanical milling at different times (from 5 to 640 minutes). Subsequently, the products of the X-ray diffraction (XRD) grinding were characterized microstructurally and morphologically and subsequently refined by the Rietveld Method. Scanning electron microscopy (SEM), characteristic X-ray energy dispersion spectrometry (EDS) and transmission electron microscopy (TEM) were also used.

The results for the refinement of the crystalline structures by the Rietveld method show that for the $Mg(OH)_2$-Al_2O_3 system the formation of the stable phase MgO is favored after 320 min of grinding and for the $Mg(OH)_2$-Y_2O_3 inhibits the formation of MgO (Fig. 1a and 1b). This result is very important since, no contamination traces of the grinding material were observed, but the formation of the new MgO phase (periclasa) does.

SEM images indicated that mechanical milling promotes the formation of agglomerates in both systems as the grinding time increases. EDS spectra do not indicate contamination of the samples by the grinding material. TEM microscopy indicated that in both systems crystal size is around 10 nm.

In conclusion, only the formation of MgO phase was observed in the first system with a very high percentage of Hydromagnesite (produced by high humidity). In the second system the Y_2O_3 phase is maintained accompanied by a high percentage of Hydromagnesite.

In both systems, mechanical grinding allows to reduce the grain size of Mg, but it is not accompanied by phase transformations of the Mg-Al and Mg-Y systems [4].

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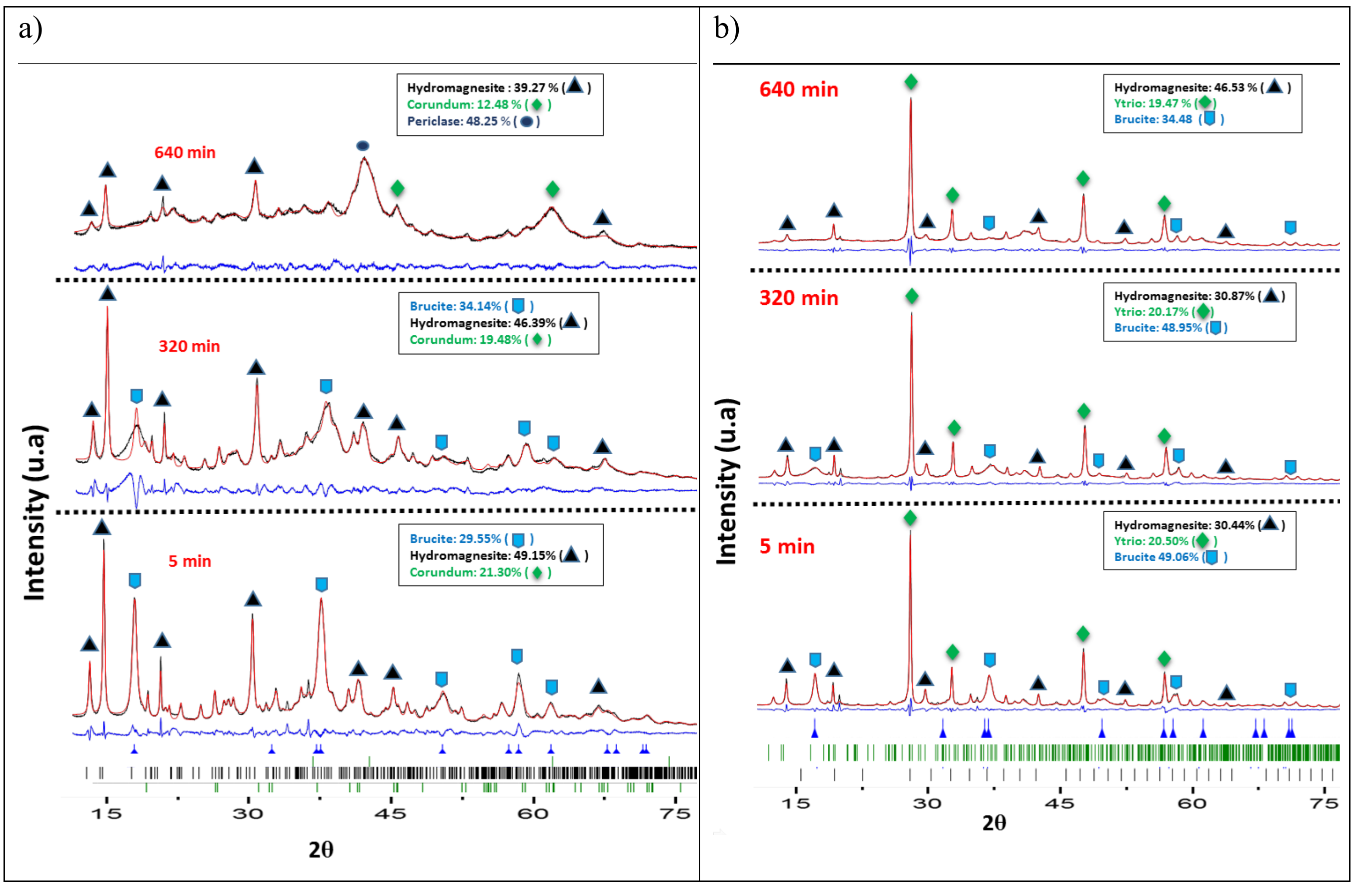

Figure 1. Diffractograms of milling systems: a) $Mg(OH)_2$-Al_2O_3 and b) Mg-$Mg(OH)_2$-Y_2O_3

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