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SYNTHESIS AND ANALYSIS OF Ti-Mg ALLOYS PRODUCED BY BALL MILLING AND HIGH PRESSURE TORSION

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ABSTRACT

The present work deals with the synthesis and analysis of $Ti_{(100-x)}Mg_x$ (x = 0, 25, 50, 75 and 100 at%) alloys obtained by Ball Milling (BM) and High Pressure Torsion (HPT).

These processing techniques have been used in this research because to the low solubility (less than 2% Fig. 1) and a big difference in their melting points ($Ti_{1668°C}$, $Mg_{650°C}$). It was found that pure Ti and rich $Ti_{(75,50)}Mg_{(25,50)}$ alloys transforms to a metastable fcc phase when stearic acid (SA) is added as a Process control agent (PCA). It was also found that Mg accelerates this phase transformation. Moreover, combining BM and HPT the formation of the fcc phase could be obtained in less time. By using NaCl as a PCA a different hcp phase could be obtained. Therefore, the resulting phase of Ti-Mg alloys will be dependent according to the synthesis method as well as the nature of PCA and its concentration.

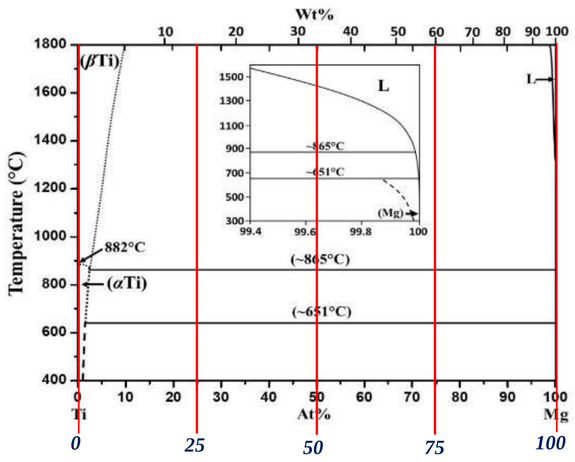
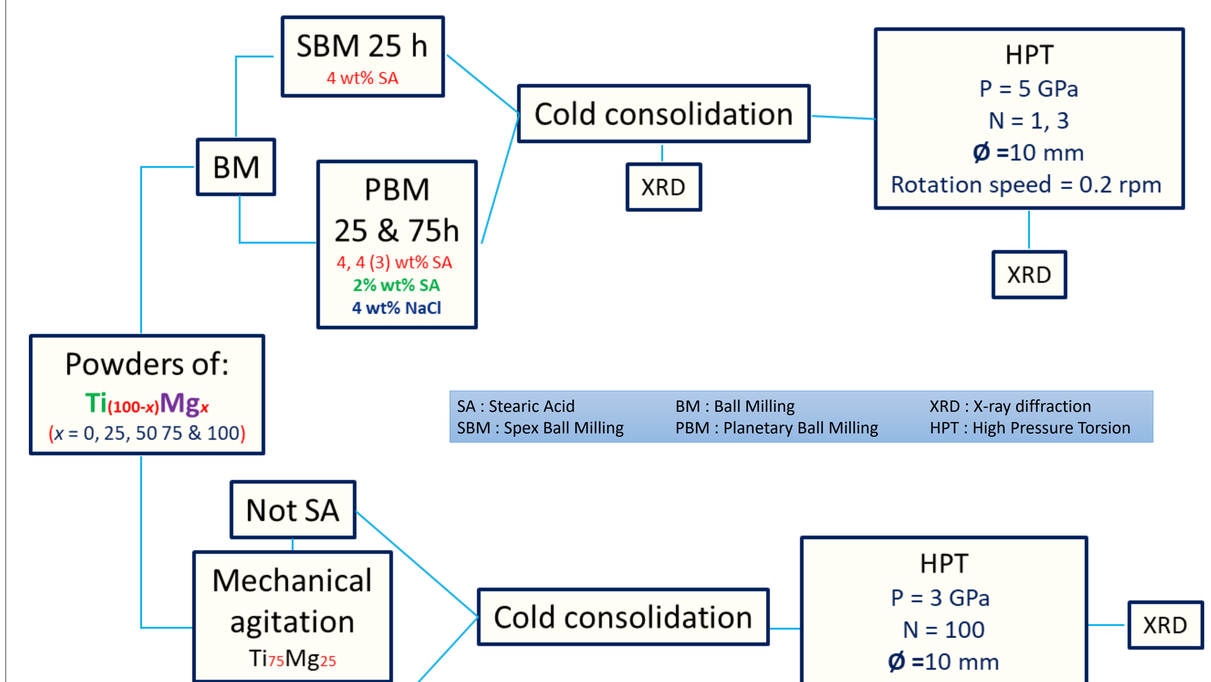


Figure 1. Binary phase diagram of Ti-Mg, as can be seen the solubility is less than 2%.

EXPERIMENTAL



RESULTS

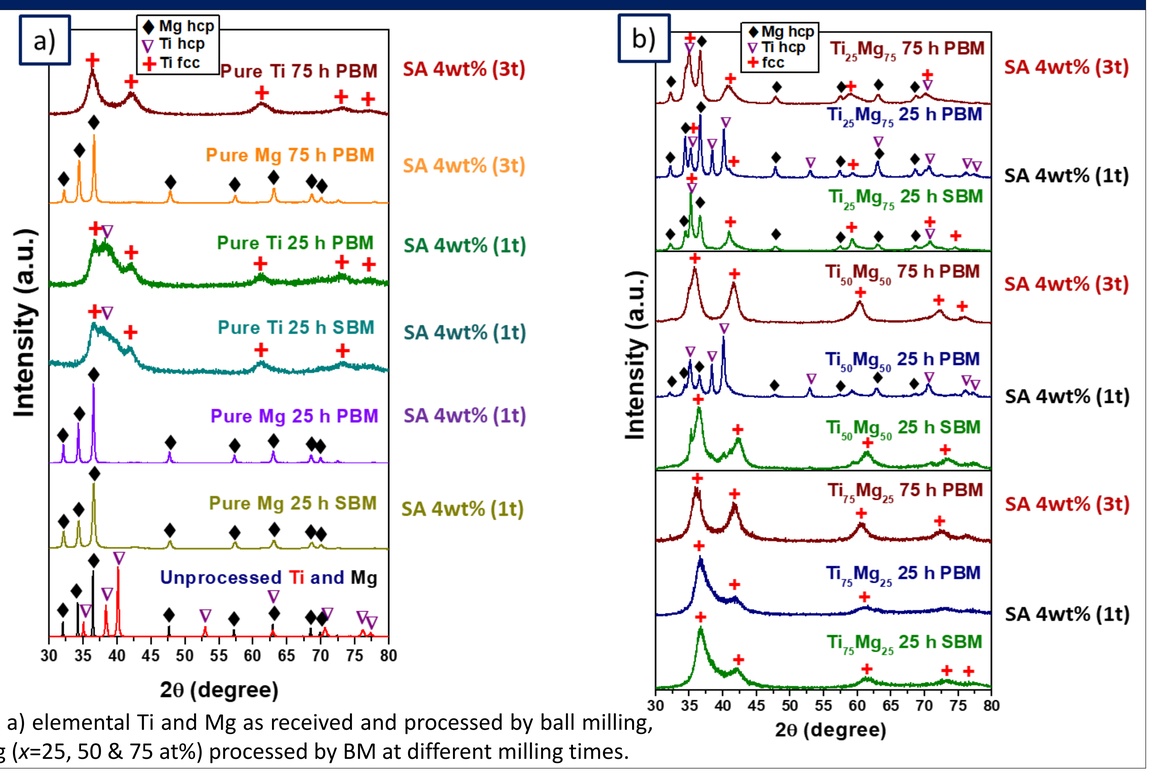


Figure 2. a) elemental Ti and Mg as received and processed by ball milling, b) Ti-*x*Mg (*x*=25, 50 & 75 at%) processed by BM at different milling times.

RESULTS

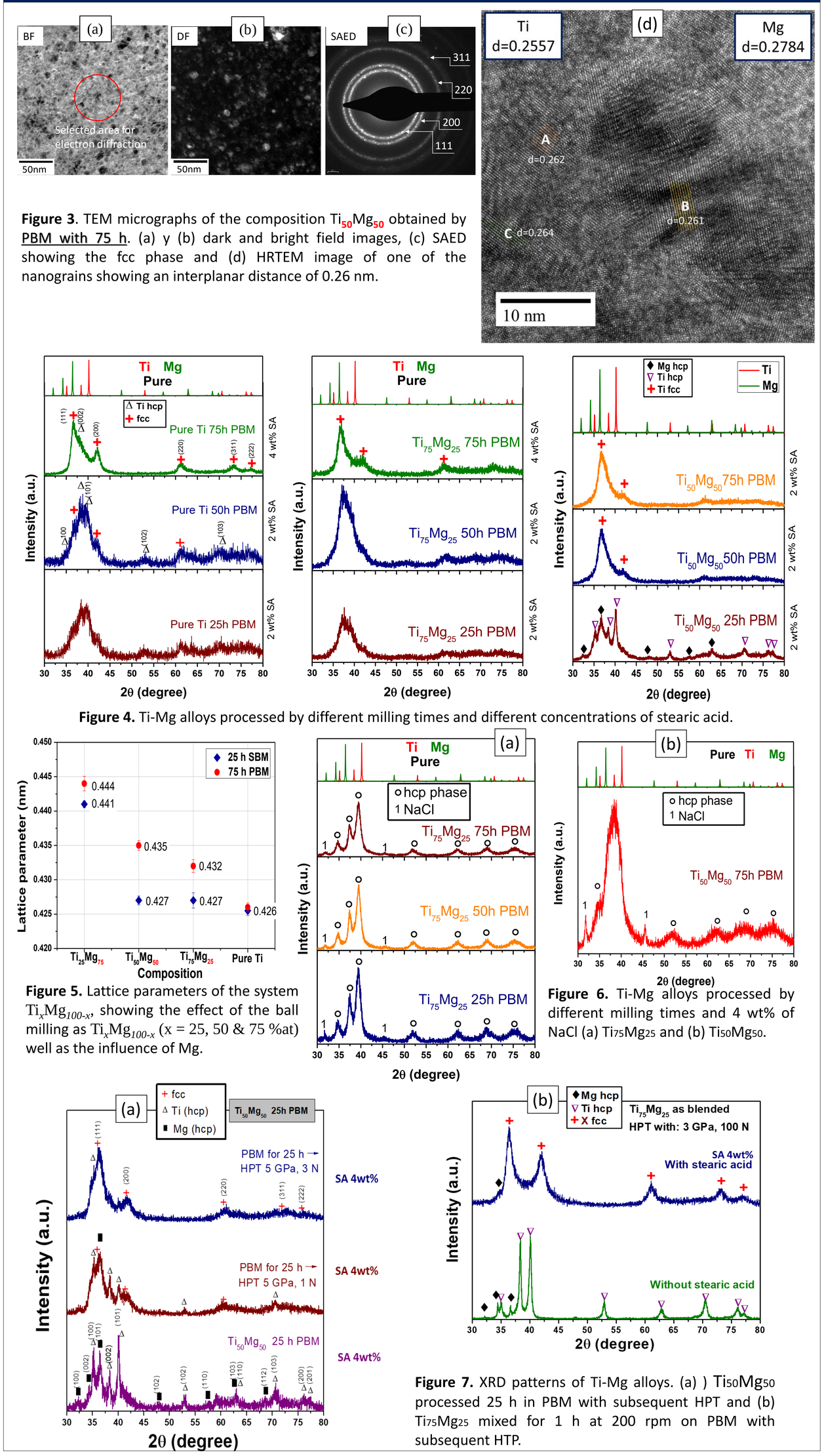


Figure 3. TEM micrographs of the composition $Ti_{50}Mg_{50}$ obtained by PBM with 75 h. (a) y (b) dark and bright field images, (c) SAED showing the fcc phase and (d) HRTEM image of one of the nanograins showing an interplanar distance of 0.26 nm.

Figure 4. Ti-Mg alloys processed by different milling times and different concentrations of stearic acid.

Figure 5. Lattice parameters of the system Ti_xMg_{100-x}, showing the effect of the ball milling as Ti_xMg_{100-x} (x = 25, 50 & 75 %at) well as the influence of Mg.

Figure 6. Ti-Mg alloys processed by different milling times and 4 wt% of NaCl (a) $Ti_{75}Mg_{25}$ and (b) $Ti_{50}Mg_{50}$.

Figure 7. XRD patterns of Ti-Mg alloys. (a)) $Ti_{50}Mg_{50}$ processed 25 h in PBM with subsequent HPT and (b) $Ti_{75}Mg_{25}$ mixed for 1 h at 200 rpm on PBM with subsequent HTP.

CONCLUSIONS

In this research, supersaturated Ti-Mg alloys have been obtained by BM and HPT, and the effect of the PCA's have been investigated.

- The use and amount of SA as a PCA improves the phase transformation resulting in a fcc phase for composition with less than 75 at% of Mg.
- Supersaturated Ti-Mg alloys with Mg are difficult to transform due to the heavily cold worked of Mg, which makes it impossible to be refined and as a consequence to transform.