Ti-Pt ALLOYS FROM MECHANICAL MILLING

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The high temperature β-TiPt phase has been shown to undergo a martensitic transformation upon quenching to room temperature[1,2,3,4]. The martensitic transformation results from a transformation of the parent B2 cubic structure to the martensitic B19 orthorhombic structure at a temperature of approximately 1000°C[3,4]. The martensite phase results in shape memory effect being observed in this alloy at this temperature. Other alloys such as TiNi and TiPd have also been investigated for the martensitic transformation and shape memory effect. The initial alloys used in the studies were arc melted then cast for TiPd and arc melted then cast or mechanically alloyed for TiNi[1,5,6]. The shape memory effect in these alloys has been observed to occur at temperatures of 520°C maximum in these alloys[7]. A few researchers have studied the martensitic transformation in TiPt alloys using arc melted cast samples. In this work high temperature shape memory alloys are targeted using powder metallurgy as a processing route.

The correct powder quantities for making TiPt alloy were measured from at least 99.5 purity powders of titanium and platinum. The powders were milled at room temperature using a high energy ball mill with a ball to powder ratio of 20:1, a speed of 800rpm, 2wt.% PCA for 32hrs. The milling was carried out under argon. The milled powders were cold compacted in a lubricated die using a hydraulic unixial press at varying pressures up to 5MPa. Sintering was carried out in a tube furnace in two stages with the initial soak for the removal of the PCA and the second soak being the sintering stage. The sintering was carried out under an argon atmosphere using of temperatures from 1300°C to 1500°C and times from 5 to 24hours.

Figure 1 shows the microstructure of the blended powder. The particles have spherical or irregular shape with a wide particle size range. Figure 2 shows the microstructure of milled powders. The particle size reduced due to milling but had a tendency to agglomerate. The agglomerates had irregular shapes with a small size distribution. Alloying of titanium and platinum also occurred during milling to form a platinum based solid solution. The powder pressed at 4MPa had a green density of 64% of the theoretical density. This green compact was sintered at 1300°C for 5hrs followed by a water quench. Figure 3 shows the microstructure of the sintered sample. A two phase region was observed. The phases were identified as a bright phase of $TiPt_3$ and a dark phase of TiPt. The microstructure did not show pores which confirm that good sintering was achieved.

References

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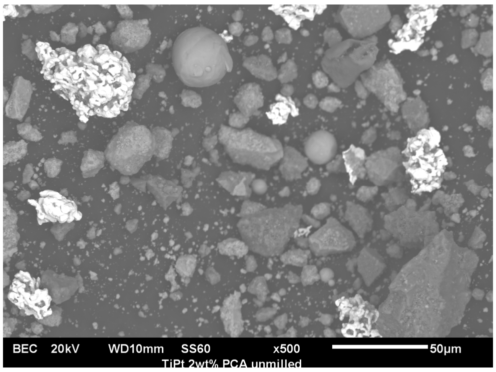

Fig. 1. BSE-SEM image of unmilled titanium and platinum powder blend for TiPt composition with Pt (light) and Ti (dark).

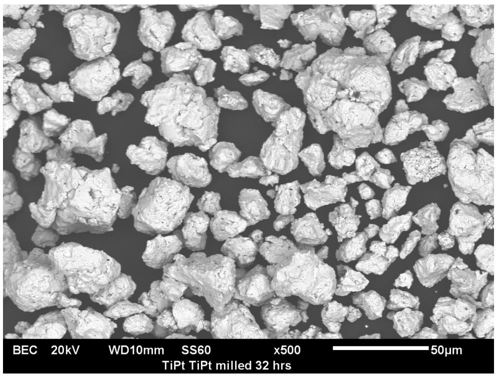

Fig. 2. BSE-SEM image milled TiPt showing a Pt solid solution.

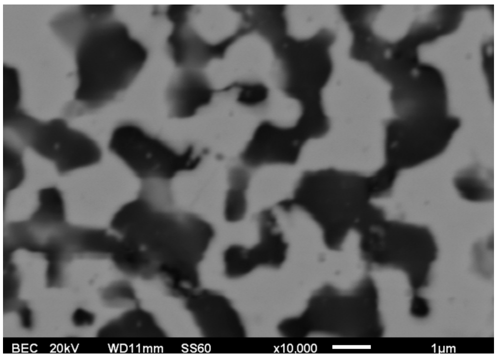

Fig. 3. BSE-SEM image of sintered TiPt showing a two phase region (bright TiPt3) and TiPt (dark)

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