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Investigation of microstructure and mechanical properties of microwave consolidated TiMgSr alloy prepared by high energy ball milling

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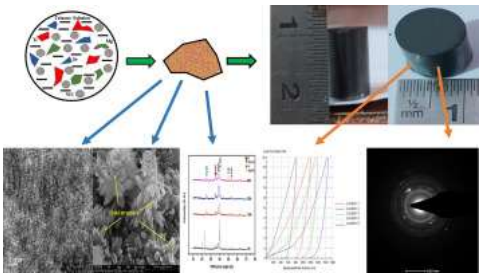
Highlights

- Powder metallurgy routes developed novel nanostructured Ti-Mg-Sr alloy.
- Nanoindentation test shows Young's moduli of 36±7GPa with hardness 1.8±0.8GPa.
- Successfully retained the nanostructure in Ti-Mg-Sr sample even after sintering.
- Developed Ti-Mg-Sr alloy could be promising for orthopedic and dental applications.

Abstract

The nanostructured TiMgSr (at.% 70:10:20) was synthesized by ball milling process followed by cold compaction and microwave sintering. XRD results after 30h milling showed crystallite size of ~41nm with a lattice strain of 2.5% and evolution of solid solutions like $Mg_{5.2}Sr$, $MgTiO_3$. The phases formed from 30h mechanically alloyed powder are in good agreement with TEM SADP results. Consolidation using microwave sintering resulted in the retention of nanostructure with crystallite size of 78nm and lattice strain of 1.2%. Densification study results in porosity of 19.8% with almost 20% density reduction compared to CP-Ti. The obtained porosity has promoted density reduction along with low elastic modulus that could be biocompatible with human bone tissue. Nanoindentation test results showed a low modulus of 36±7GPa with a hardness of 1.8±0.8GPa. These results are comparable with those Ti alloys produced by various techniques and found to be relatively superior for biomedical applications.

Graphical abstract



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