Titanium Based Amorphous Alloys for Biomedical Application

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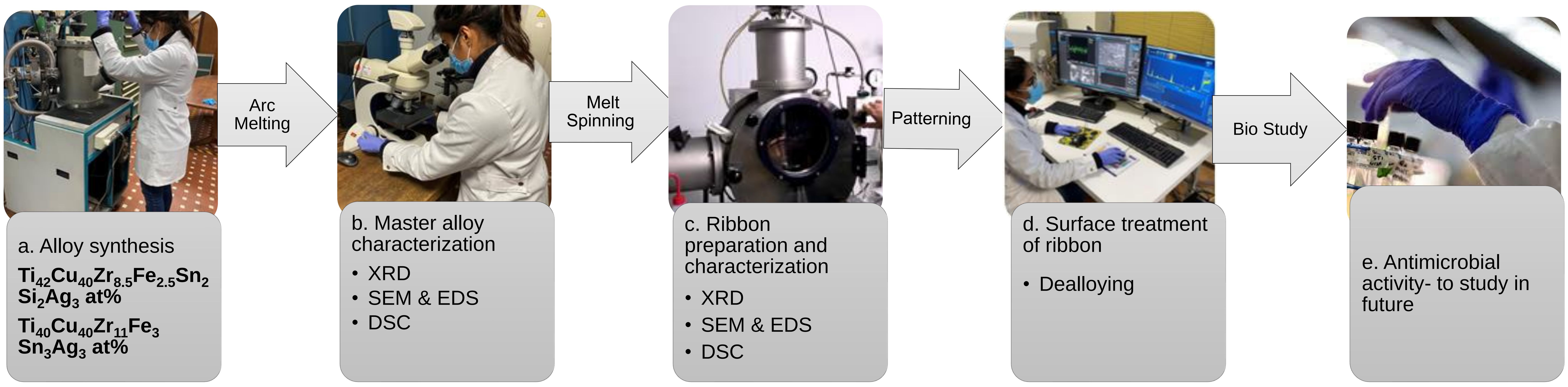
INTRODUCTION

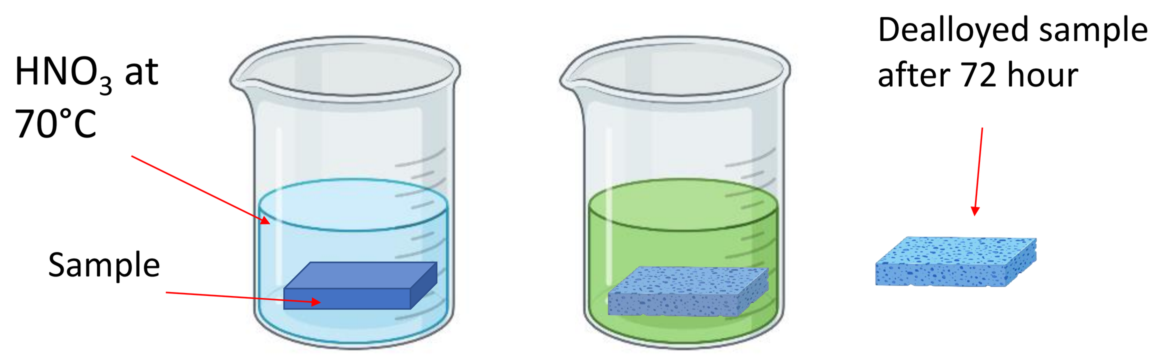
Titanium based biomaterials have been widely used for implant application due to their high load bearing capacity, corrosion resistance and relatively lower Young's modulus. However, due to both high stress shielding effect and implant infections, there are several cases of implant rejection in patient's body. To overcome this problem, two Ti-Cu based alloy were selected and modified from literature to produce metallic glass ribbons with $Ti_{42}Cu_{40}Zr_{8.5}Fe_{2.5}Si_2Sn_2Ag_3$ at% (MA1) and $Ti_{40}Cu_{40}Zr_{11}Fe_3Sn_3Ag_3$ at% (MA2) the combination contains biocompatible elements which possess good glass forming ability and good mechanical properties [1] [2].

OVERVIEW



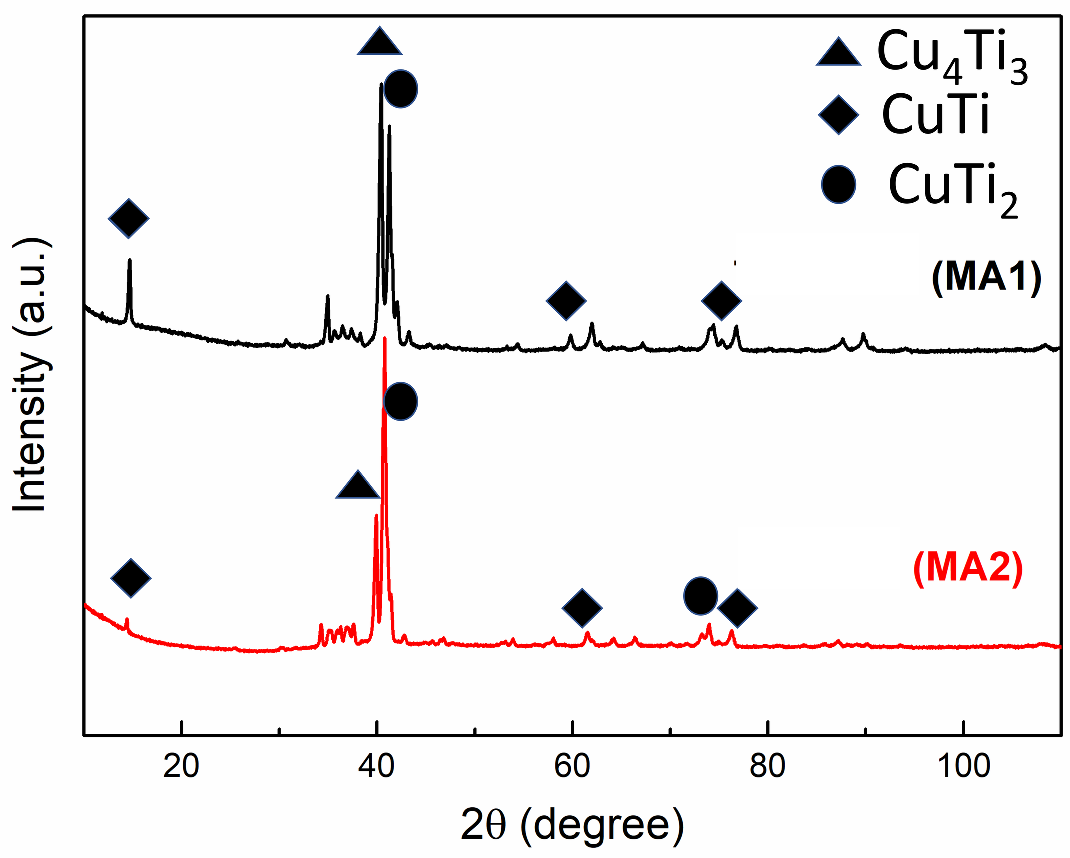
MATERIALS and METHOD

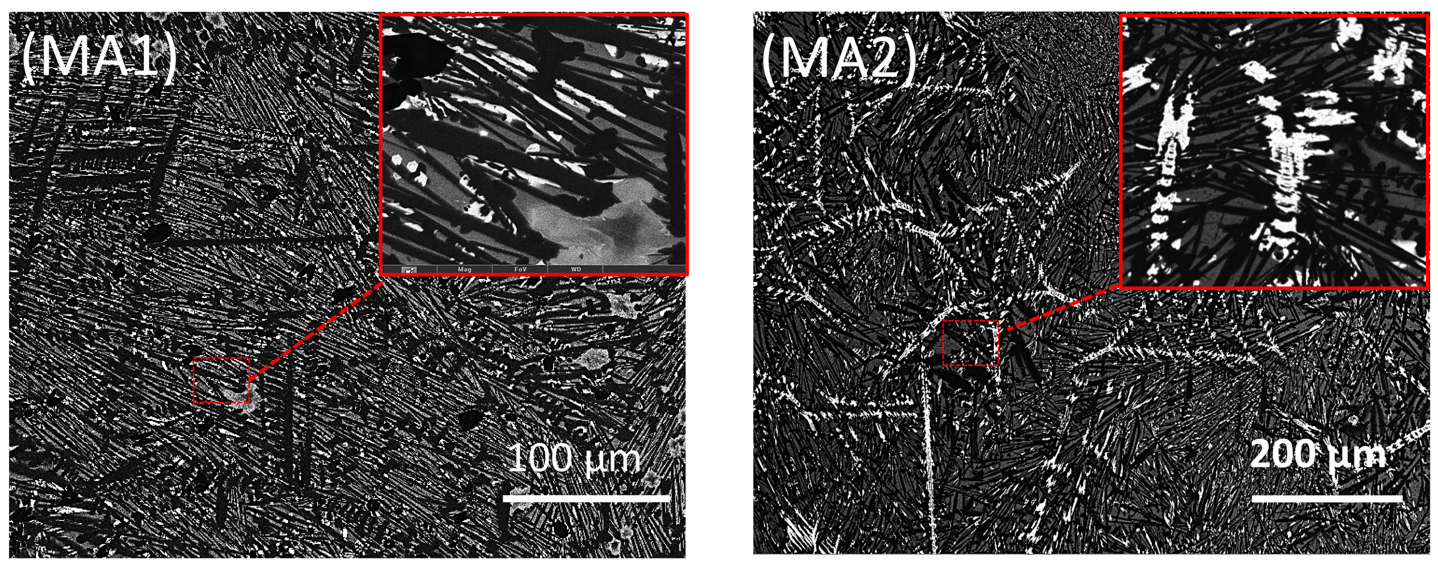
Two master alloy with composition $Ti_{42}Cu_{40}Zr_{8.5}Fe_{2.5}Si_2Sn_2Ag_3$ at% (MA1) and $Ti_{40}Cu_{40}Zr_{11}Fe_3Sn_3Ag_3$ at% (MA2) was developed by melting pure elements in arc melting under argon atmosphere. Metallic glass ribbons were prepared using planar flow casting technique. The ribbon samples were chemically dealloyed using 14.6 M HNO_3 solution at 70°C for 72 hour to produce nanoporous TiO_2 layer on the surface of the sample[3].



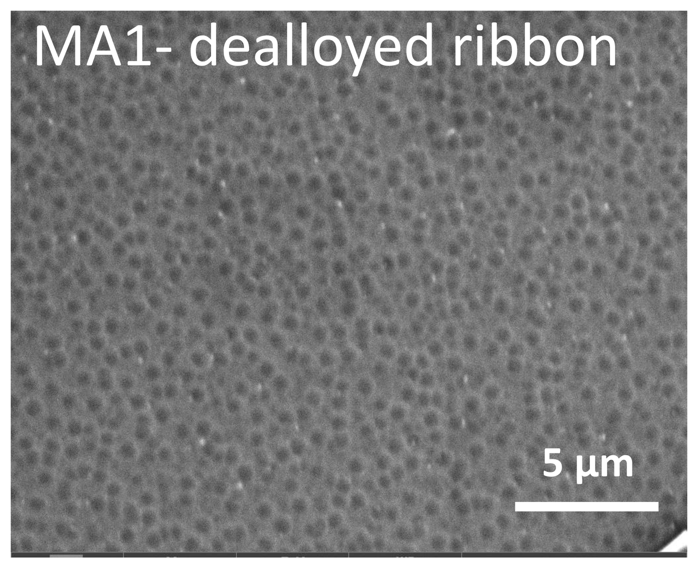
Schematic representation of chemical dealloying method

RESULTS

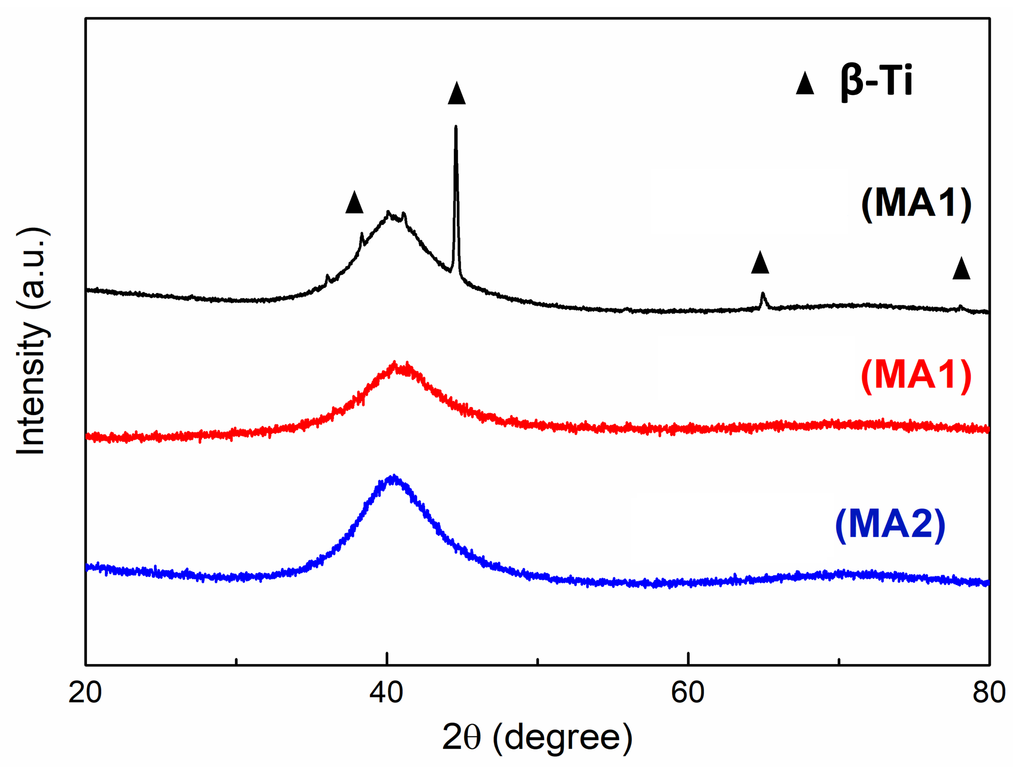




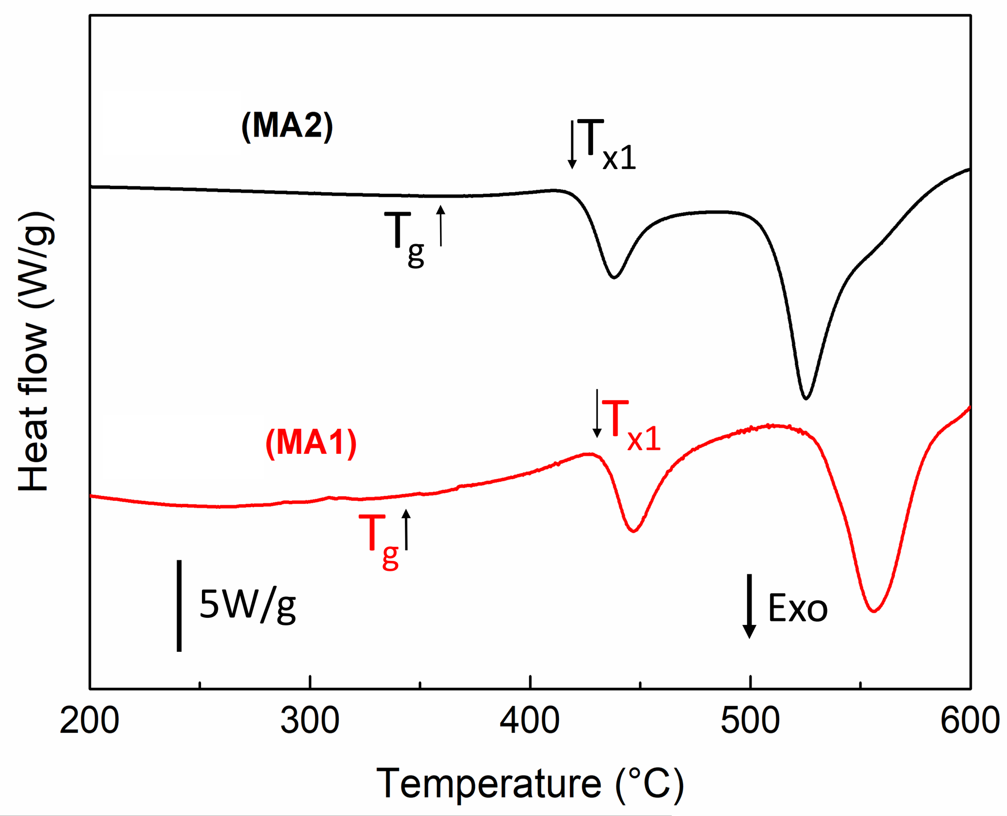
XRD patterns and SEM images of microstructure of master alloy 1&2, the pattern of MA1 and MA2 alloy consists of CuTi, $CuTi_2$, Cu_4Ti_3 phases



The SEM image of dealloyed sample with porous structure after 72 hour treatment in 14.6M HNO_3 at 70°C



XRD analysis of MA1 and MA2 as quenched ribbon samples



DSC analysis of as quenched ribbon samples of MA1 and MA2 master alloy with T_g= MA1: 370°C, MA2: 377°C and T_x= MA1: 433°C, MA2: 422°C

CONCLUSION

A comparitive study was performed to understand the presence of Si in MA1 and MA2 on its GFA and possibility to attempt the dealloying process. It was understood that removal of Si from MA2 did not affect the GFA of ribbon samples.

The ribbon samples showed porous morphology after the chemical dealloying treatment. The bioactivity of the samples will be studied in the future to understand antimicrobial activity of the treated sample.

REFERENCES

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BIOREMIA European Training Network

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