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Study of the microstructure and crystal orientation of as-cast Ti-10.2Mo-19.5Nb alloy

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Abstract
Ti-based alloys particularly metastable ß-type Ti alloys have been attracting an increasing attention as crucial biomedical materials in the past few decades due to their moderate strength, good corrosion resistance, good biocompatibility, low elastic modulus and high ductility. This work is aimed at studying the microstructural evolution and the crystal orientation of metastable ß-type Ti-Mo-Nb alloy designed using the MoEq, d-electron theory and e/a ratio approaches. This is a preliminary study on the thermo-mechanical processing of the designed alloy, which could produce alloys with lower elastic modulus (˜ 35 GPa) when all the ß phase have the same planar orientation. The optical microscopy (OM) was used to perform microstructural analysis while the electron backscatter diffractometer (EBSD) was utilized for the crystal orientation. Also, Phase identification was conducted using the X-ray diffractometer (XRD). Results show that the EBSD microstructure of as-cast Ti-10.2Mo-19.5Nb alloy revealed the presence of orthorhombic martensitic a phase precipitates in the ß phase matrix. However, no orthorhombic martensitic a phase was observed in the optical micrograph and the XRD pattern. Furthermore, no precipitates of phase was revealed by the three analytical techniques, probably due to its small size (nm) in the alloy. The crystal orientation was random. In as-cast condition, this alloy has shown a lower elastic modulus than those of the conventional orthopaedic implant materials including Ti6Al4V (110 GPa), CoCr (220 GPa) and 316L stainless steel (205 GPa).