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HIGH ENTROPY ALLOY FROM MoNbTaTiZr SYSTEM WITH YTRIUM FOR MEDICAL APPLICATIONS AND CONSOLIDATION PROCESS

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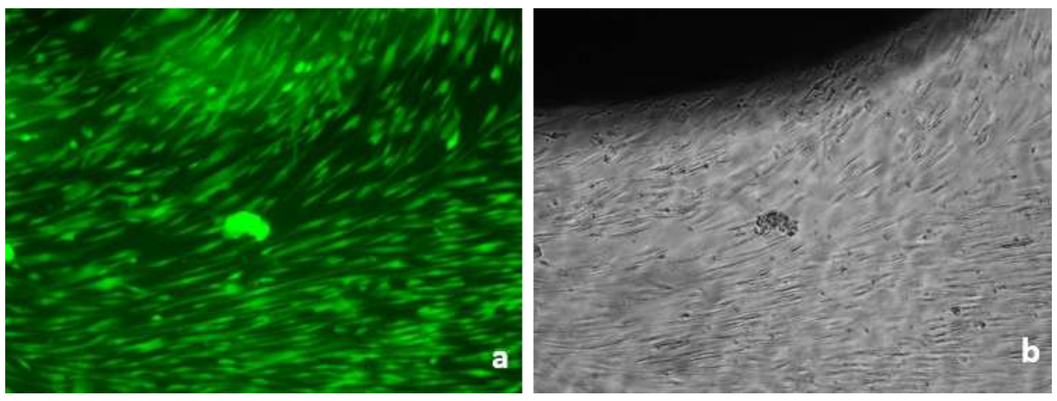
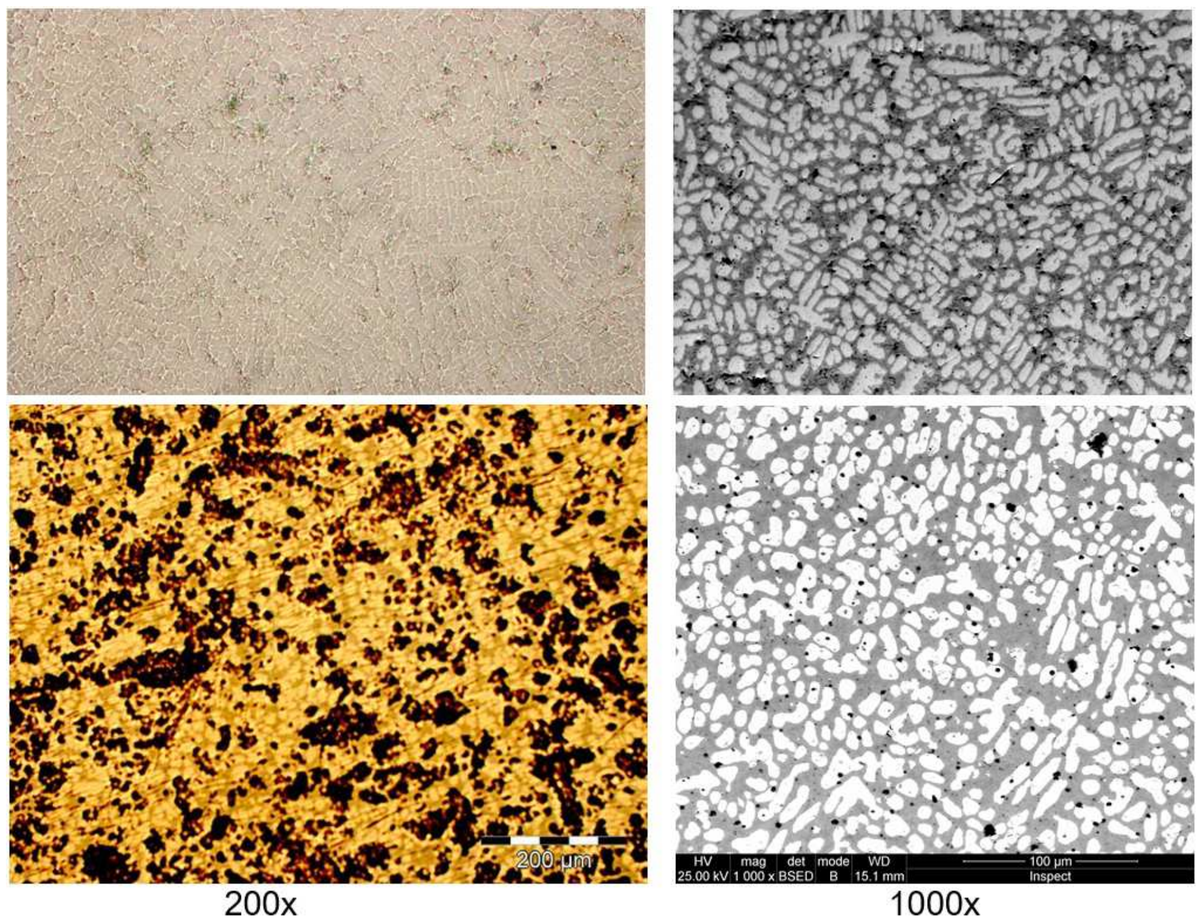
Water-cooled copper plate in which the metallic materials of the load are placed in order to melt high entropy alloys under an inert argon medium in the RAV installation.



Viability, adhesion and proliferation of the human fibroblast cell line on contact with the alloy: a) 100x fluorescence; b) FOV phase contrast 100x, after 10 days.



200x 1000x

The Microstructure of the biocompatible MoNbTaTiZrY alloy after the application of the heat treatment. Homogenization of the dendritic bi-phase solid solution and quenching of intermetallic compounds (1000x).

The multi-element biocompatible alloy MoNbTaTiZr microalloyed with Y for medical applications of the present invention simultaneously has high hardness and compressive strength values, being composed of five metal elements of advanced purity, having the equimolar chemical composition of: Mo = 18.86 %; Nb = 18.27%; Ta = 35.56%; Ti = 9.43%; Zr = 17.88%: and the percentage composition imposed by: Mo = 17 - 19%; Nb = 17 - 19 %%; Ta = 34 - 36%; Ti = 8.5 - 10%; Zr = 16.5 - 18.5%, microalloy with yttrium in proportions between Y = 0.1 - 0.5% to reduce brittleness, granulation finish, reduce the tendency of brittle fracture, globulation of oxide films separating on the boundaries grains, inhibition of the tendency to segregate sulfur at grain boundaries with beneficial consequences for increasing intergranular cohesion and reducing the tendency to crack or weaken, reducing the total concentration of dissolved oxygen in the metal matrix and improving toughness, having a density in the range 10.5 – 11.3 g/cm3 and liquid temperature between 2300 – 2500 degrees C. This alloy can be obtained by a melting process in a vacuum spring remelting (RAV) installation, with melting at least 5 times and rotating on the seating surfaces to homogenize the chemical composition and the microstructure, whose mechanical characteristics can be increased by applying a heat treatment of homogenization at 900oC with maintenance for 2 hours, followed by rapid cooling in water, from average hardness values between 515 - 565 HV0.5 to average hardness values between 850 -1000 HV0. 5. The biocompatibility of the alloy has been demonstrated by cell proliferation tests up to 100% confluence of the human fibroblast line, both in the vicinity of the alloy and on its surface.

ADVANTAGES:

- The material made is homogeneous and has concomitant properties of high hardness and biocompatibility, being microalloyed with Y to finish the granulation and to reduce the risk of embrittlement by uniform dispersion of oxide films;
- It allows obtaining in the metallic structure high hardnesses by applying short-term heat treatments and at lower temperatures than other similar alloys in the literature, reaching values of 1000 HV0.5;
- The chemical composition can be rigorously controlled within the technological process of obtaining by using some metallic materials of advanced purity in vacuum remelting installations;
- The heat treatment procedure provides protection against oxidation of the material, by packing in aluminum foil and wrapping in kaolin and then placing it in the treatment furnace under a layer of quartz sand.

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