

## HIGH ENTROPY ALLOY FOR MEDICAL SURGICAL APPLICATIONS IN THE FeMoTaTiZr METALLURGICAL SYSTEM AND METHOD OF OBTAINING

### Authors:

GEANTĂ Victor, VOICULESCU Ionelia, ȘTEFĂNOIU Radu  
BINCHICIU Horia,  
VIZUREANU Petrică, SANDU Andrei Victor, BĂLȚATU Simona,  
KELEMEN Hajnal,  
CODESCU Mirela Maria, MARINESCU Virgil

– UNIVERSITY POLITEHNICA OF BUCHAREST

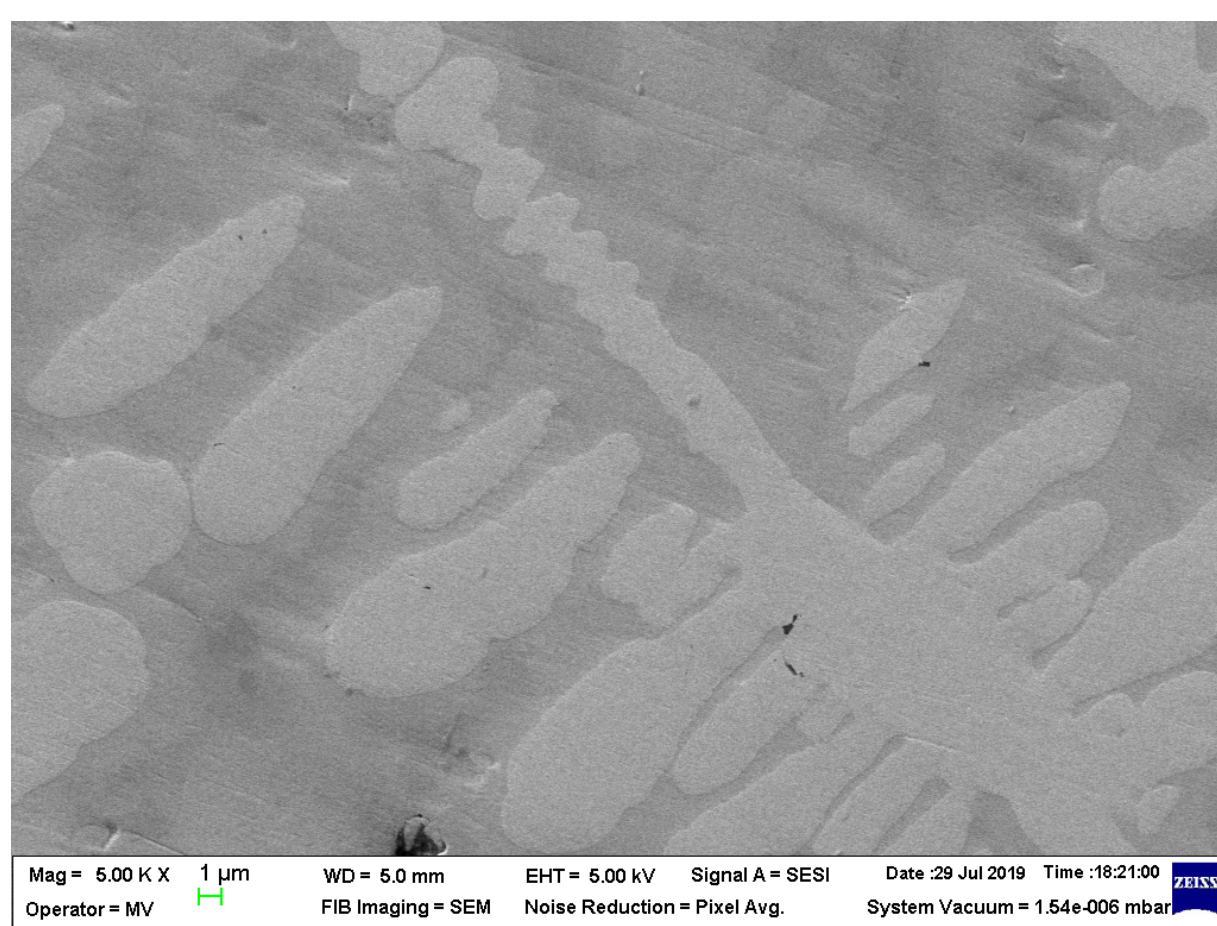
– SUDOTIM AS TIMISOARA

– GHEORGHE ASACHI TECHNICAL  
UNIVERSITY OF IASI

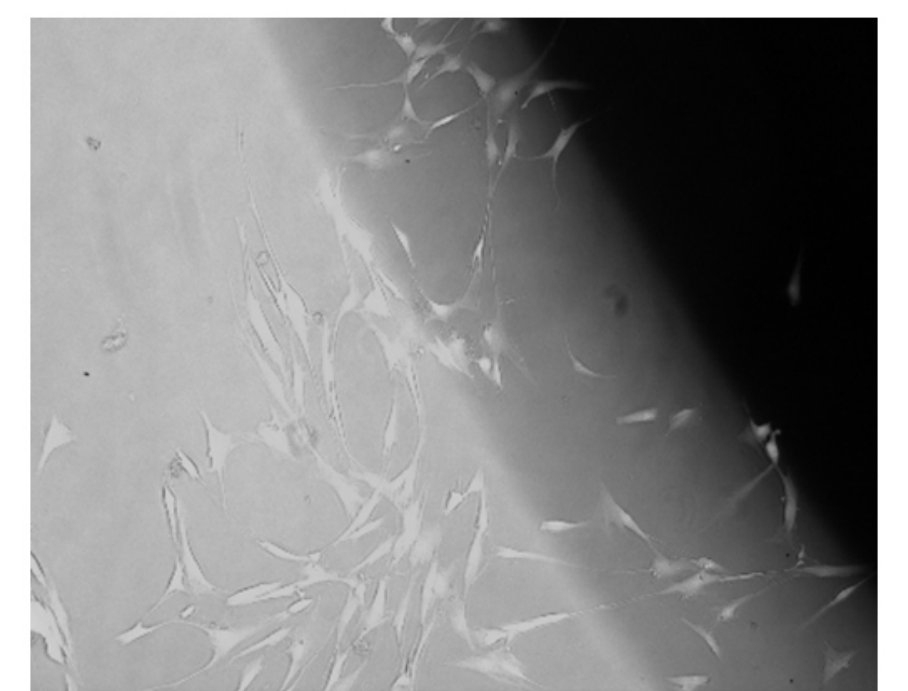
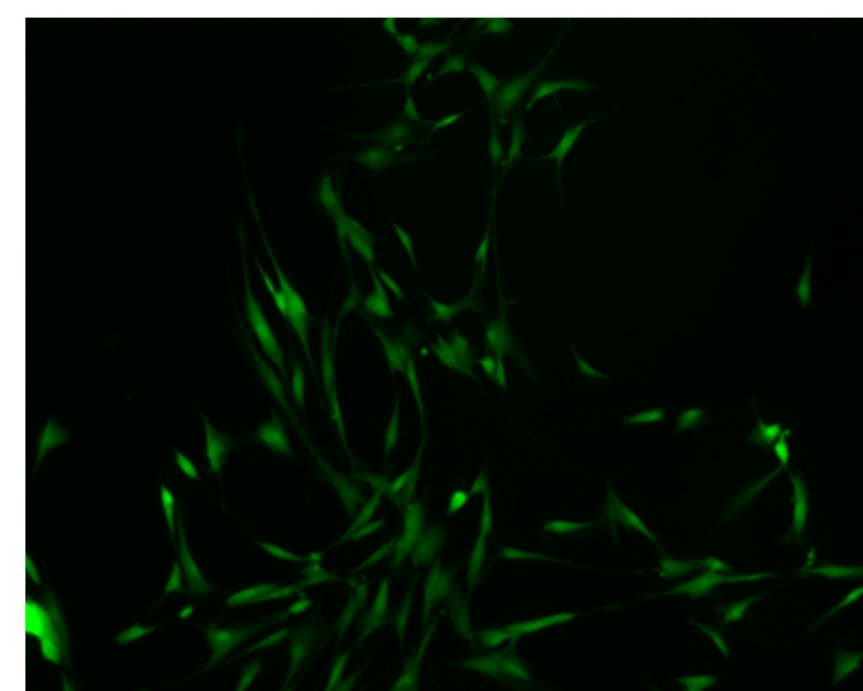
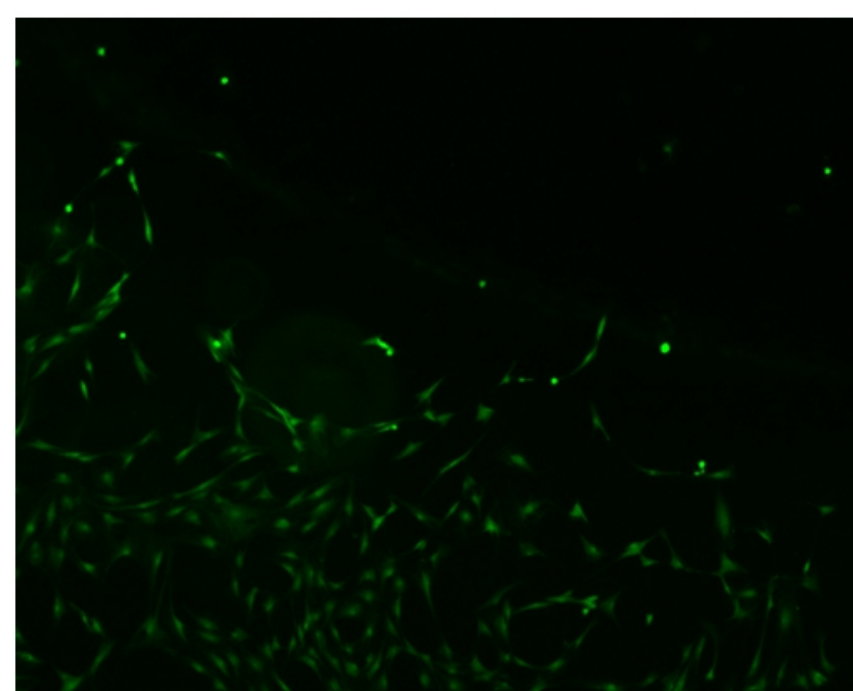
– UNIVERSITY OF MEDICINE, PHARMACY,  
SCIENCE AND TECHNOLOGY TARGU MURES

– N.I.R.D. FOR ELECTRICAL ENGINEERING  
ICPE CA BUCHAREST

Patent Pending  
OSIM  
RO134978



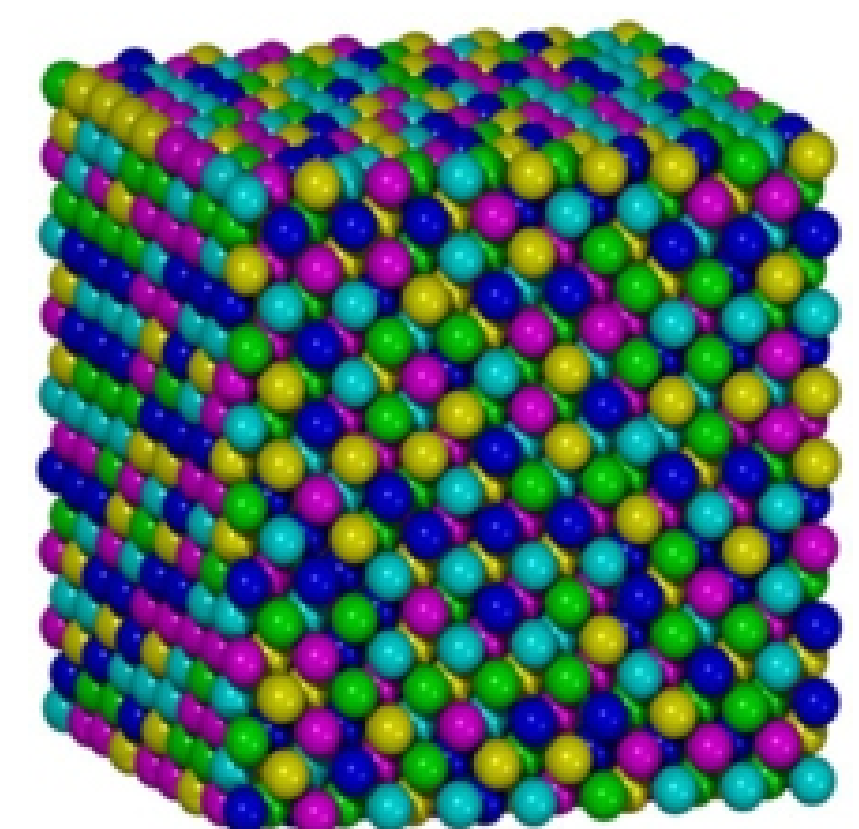
Casted state alloy



Viability, adhesion and proliferation of mesenchymal stem cells isolated from bone tissue on FeMoTaTiZr alloy samples in fluorescence (50x); fluorescence (100x) and phase contrast (100x).



The metallic load on the  
copper plate  
and the resulted  
miniingots



The present invention relates to a high metal entropy from the FeMoTaTiZr system, consisting of elements with the lowest biotoxicity on the human body, used in the medical field for orthopedic implants, characterized in that it has a very good biocompatibility, behavior appropriate to processing mechanical and high mechanical strength in conditions of wear bone-alloy system, combined with mechanical fatigue, as well as the process of obtaining it.

The alloy with high entropy from the FeMoTaTiZr system, consists of elements with the lowest possible toxicity to the human body and which is the object of the invention, has high hardness and toughness, being composed of five metal elements of advanced purity, having chemical composition located in the value ranges, as follows: Fe = 9.5 - 12.5%, Mo = 19 - 22%, Ta = 36 - 40%, Ti = 9 - 11.5%, Zr = 18 - 21% with a density of 10.8 - 12 kg / dm<sup>3</sup> and a melting temperature of 2300 - 2400°C, material which before heat treatments (in the molded state) has average microhardness values of 694 HV0.5, and after the application of specific heat treatments ( heating up to 900°C, stationary on the bearing for 2 hours, hardening in water) has an associated hardness of 800 HV0.5, being obtained by melting and homogenization in a vacuum spring remelting plant under a protective argon atmosphere.

- The process for obtaining the high entropy alloy is characterized by the fact that the metallic materials used to obtain Fe, Mo, Ta, Ti, Zr are of the most advanced purity (over 99.3%), selected and mechanically prepared suitable for introduction into the RAV (Vacuum Arc Melting) installation, which ensures the working temperature under the action of the electric arc of at least 3500 degrees C, with pressure level of 3x10<sup>-3</sup> mbar and then with argon atmosphere, with load calculation that account of the losses of elements that occur during the elaboration process, losses depending on the size of the working cell, the selection (order of addition) and the way of working, the order of addition being Ti, Zr, Ta, Mo, Fe to create a metal baths capable of rapidly dissolving elements with high melting temperature.

### CONTACT

E-mail: [euroinvent@yahoo.com](mailto:euroinvent@yahoo.com)

Web: [www.afir.org.ro](http://www.afir.org.ro) & [www.euroinvent.org](http://www.euroinvent.org)

President: Eng.PhD. Andrei Victor SANDU