43rd STUDENT CONFERENCE (E2)
Student Team Competition (3-V.4)

Author: Ms. Elena Sorina Lupu
Politechnic University of Bucharest, Romania, lupusorina@yahoo.com

Mr. Claudiu Cherciu
Politechnic University of Bucharest, Romania, cherciu_claudiu@yahoo.com
Ms. Laura Manoliu
Politechnic University of Bucharest, Romania, laura_mnl@yahoo.com
Ms. Ioana Ciuca
Durham University, United Kingdom, ioana.ciuca@durham.ac.uk
Mr. Ion Ciobanu
Politechnic University of Bucharest, Romania, ciobanu.nelu@hotmail.com
Mr. Camil Alexandru Muresan
Politechnic University of Bucharest, Romania, murcamil@gmail.com
Mr. Dan Dragomir
Politechnic University of Bucharest, Romania, dan.dragomir@cs.pub.ro
Mr. Costel Nachila
Romania, nachila.costel@yahoo.com
Ms. Claudia Chitu
Romania, chituclaudia@gmail.com
Mr. Cristian Soare
Politehnica University of Bucharest, Romania, soare_cristian16@yahoo.com

INVESTIGATION OF THE SURFACE DEFORMATION AND DENDRITIC SOLIDIFICATION OF TITANIUM ALLOY MELTED IN MILIGRAVITY

Abstract

With the construction of the International Space Station, microgravity research has enabled many scientific breakthroughs. Moreover, new materials can be synthesized under low gravity conditions. In particular, in our analysis, an investigation on the surface deformation and on the dendritic solidification of titanium alloy melted on Earth-based laboratory conditions and on board of a sounding rocket is performed [1]. This paper represents the first part of an ample research and is concerned with describing the rocket module platform [1] that will fly during the REXUS 15/16 campaign [2] from Kiruna, Sweden and the results obtained during the on-ground experiment. Also, it includes a detailed research regarding the hypothetical differences that will be obtained during the sub-orbital flight.

The experiment contains a multimode LASER diode with an output power of 25W that will melt samples of Ti6Al4V covered with nanotubes. The nanotubular array is elaborated in Polyethylene glycol (PEG 600). The research follows to understand the changes in microstructure, especially in the dendritic distribution. The results obtained on Earth conditions are presented in the Results section and then commented in the Discussion section. Here, we propose a comparative analysis with the results obtained in reduced gravity conditions (in the rocket), where we expect a difference in the dendrite geometry, particularly an increased spacing in the dendrites of the alloy samples that solidify in low gravity. [3] The paper also contains a mathematical model of the heat transfer mechanism in reduced gravity, where there is no heat convection and the process of heat transfer is purely diffusive. The second part of our research

is concerned with the experiment on board of the rocket, when, during the 90 seconds of miligravity, the LASER is expected to melt the samples. The environmental parameters are going to be monitored using sensors and the melting process is recoded with a camera.

In conclusion, we take into consideration the fact that the only parameter that differs between the on-ground and the on board of the rocket experiments shall be the level of gravity (the pressure, temperature and humidity must remain the same). So, a proficient comparison between the low gravity and normal gravity effects can be undertaken. The rocket launch is scheduled in March, 2014.

[1] Student Experiment Documentation http://media.wix.com/ugd//6d82a9$_4$3993f425d946db024d0$f$baa37538195.pdf

[2] http://www.rexusbexus.net

[3] Curreri, RA, Lee, JE Stefanescu, DM 1988, Dendritic Solidification of Alloys in Low Gravity, Metallurgical Transactions, Volume 19 (11), pp. 2671-2676