IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

Author: Prof. Taig Young Kim
Korea Polytechnic University, Korea, Republic of

Mr. Hee Rak Kim
Korea Polytechnic University, Korea, Republic of

STUDY ON THE GRAVITY DISPERSION ACTING ON A SPECIMEN DURING OPERATION OF THE RANDOM POSITIONING MACHINE

Abstract

Although there has been still no study that can confirmed whether the random positioning machine (RPM) properly simulates the space microgravity, it is still significant in the bioscience by creating a new external environment in which the gravity acting on a specimen is omnidirectionally dispersed over time. Lots of experimental studies have been published on cell culturing under RPM operation with various combinations of angular velocity, which is important in time-dependent gravity dispersion, but few to evaluate its quantitative effect has been presented. In this study, a degree of gravity distribution in certain direction is mathematically analyzed for the RPM working duration. The total solid angle in omnidirection is evenly divided into finite solid angles (the smaller the better resolution) to assess degree of gravity dispersion. Ratio for accumulated residence time of gravity vector in a finite solid angle to total RPM operation time can be considered as a degree of distributed gravity level in that direction. In case of RPM operation with a constant angular velocity, it is inevitable that the degree of dispersed gravity is relatively strengthened at both ends of the outer rotation axis. The time varying angular velocity was proposed to resolve it by shortening the residence time of the gravity vector in such directions. The optimal angular velocities to simulate planet reduced gravity on the Moon or Mars were also presented through mathematical analysis. Angular acceleration as well as centrifugal force are induced by the time varying rotation of RPM, and the effect of resultant secondary forces were also analyzed. We manufactured a RPM capable of the transient operation, and in particular, developed an incubator to control temperature, humidity, and CO2 concentration by itself during rotational motion. The stability of the inhouse RPM was verified through proliferation and culture of mesenchymal stem cells.