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SHAPE DEVELOPMENT AND ANALYSIS FOR 3D-PRINTED HIGH-RESOLUTION MULTIPLE ELECTRODE HARMONISED KINGDON TRAP

Abstract

Mass spectrometry is proven method for determination of the substance chemical composition which is based on the identification of compounds through accurate mass measurements of their molecules. Mass spectrometry is suitable for a variety of applications in chemistry, medicine, and in space exploration. In recent missions, it was used for analysis of interplanetary medium; upper and lower planetary atmospheres; chemical composition of planets and small body environments. Mass spectrometers for space research become smaller, with low weight and low power consumption. This tendency encourages industry to develop a new generation of miniaturized mass spectrometers with better characteristics. Ion Traps are frequently used in cases when sensor miniaturization is needed. One of the types of the ion traps which was not used so far for this application is Kingdon trap. Such type of mass spectrometer could have the ion's mass resolution more than an order higher than the resolution of the currently used instruments. Mass spectrometers operates under vacuum conditions which makes these instruments ideally applicable for moon exploration. The perspective mission could be on the polar caps of the moon for soil analysis. The Lunar Crater Observation and Sensing Satellite (LCROSS) finds ice deposits at Moon's North Pole, and such mass spectrometry mission could give us more information about the composition of the rest of the soil. The main problem of making the Kingdon trap is connected to its very complicated geometry with lack of rotational symmetry. Additive technologies are appropriate in this case. 3D printing provides possibility to meet all requirements of the Ion Trap's manufacturing and even open new opportunities as quick modification for the new geometries. The goal of this research is to create the high precise 3D model of the ion trap and conduct thermomechanical analysis for the space environment. The results of the research are implemented during manufacturing via high precise metal 3D printing. At this point, we have produced the prototype, conducted surface quality analysis and first tests. The authors would like to acknowledge the support from Next Generation Program.