SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

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DESIGN, DEVELOPMENT AND PERFORMANCE FACETS OF A PROTOTYPE LASER INDUCED BREAKDOWN SPECTROSCOPE (LIBS) INSTRUMENT FOR CHANDRAYAAN-2 ROVER

Abstract

With the awe-inspiring success from the first interplanetary mission, Chandrayaan-1, the Indian space agency is set to launch its successive mission to Moon, Chandrayaan-2 in the late 2013. The conceptualized Chandrayaan–2 mission is an orbital flight vehicle similar to Chandrayaan-1, which will consist of a spacecraft and a landing platform with the moon rover. The rover will have two scientific payloads and one of those is the LIBS-laser induced breakdown spectroscope to perform in-situ elemental analyses on lunar surface. In consideration with the mission constraints such as weight, size, power and available lens-to-surface-distance, a miniature LIBS instrument has been conceptualized and possibilities of implementation have been studied. Conceptualization and study aspects of the instrument realization were presented elsewhere. Further to that, this paper sheds the light on the other phases of the instrument realization in term of design and development of a prototype instrument model. The developed in-situ prototype LIBS is a 1.0 kg instrument with a footprint of 180 mm x 150 mm x 80 mm suiting the lens-to-surface-distance of 200 mm and collects the plasma light with the collection optics having full field-of-view of 28 degrees. This instrument is capable of generating the power density in the order of 100 gigawatt per unit area at defined lens-to-surface-distance. LIBS prototype development incorporates novel approaches and techniques, especially in spectrograph design and processing electronics. LIBS prototype instrument can operate at 200 kHz frequency and employs a 16-bit data command to support numerous operational modes that were identified to retrieve decent science from the instrument. Nearly 60 types of standard/certified reference samples were identified and procured to experiment under extreme vacuum conditions in order to generate the calibration curves for precise quantitative measurements. A flight in-situ instrument of the same is expected to be <1.0 kg that consume < 5W power. Through this paper authors would like to present design and development aspects of the LIBS prototype instrument at its different phases along with the material selection, design simulations and performance prospects.