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BIOLUMINESCENCE IMAGING DETECTION TECHNOLOGY APPLIED TO SPACE LIFE SCIENCE

Abstract

Bioluminescence imaging detection technology is an important tool in modern life science research. Usually bioluminescence signals are very weak and an extremely sensitive imaging detection technology should be needed. According to the need for the detection of weak bioluminescence in the space life science experiments, a highly sensitive detection method developed for space application is discussed. A bioluminescence imaging detection instrument is designed and its space flight experiment results are introduced in the paper. 1) On the basis of feature analysis of chlorophyll fluorescence, GFP fluorescence and quantum dots of the different types of bioluminescence, the advantage of EMCCDs technology in space application is summarized briefly compared to other low-light detection technology, system scheme of a bioluminescence imaging detection instrument suitable for space life science experiment is designed. 2) An optical signal transmission model of bioluminescence imaging detection instrument is built. According to the characteristic of EMCCD, associated high voltage driver clock, the timing driven and the high speed data transmission are demonstrated and designed in details. The system detection sensitivity of the bioluminescence imaging detection instrument is estimated and the influencing factors are analyzed. The feasibility of EMCCDs applied in bioluminescence imaging detection is illuminated. 3) A calibration solution of the bioluminescence imaging detection sensitivity is established, and the calibration error is estimated and analyzed. Based on the calibration, the actual detection sensitivity is revised. The plant leaves, GFP arabidopsis, quantum dots are used for the bioluminescence imaging detection verification experiment effectively. The bioluminescence imaging detection instrument has been applied in space life science research, and GFP fluorescence of arabidopsis leaves, multiple stem cells have been detected and observed successfully in space flight experiment. Detection result and instrument improvement are discussed.