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THE DESIGN OF INSTRUMENT FOR DETECTING MICROORGANISMS IN SPACECRAFT WITH  
PCR BIOCHIP AND EMCCD CAMERA**Abstract**

As an important tool for human exploration of space, the spacecraft is the home of astronauts outside the earth. The occurrence of microorganisms in spacecraft due to contamination is a health risk to the astronauts and control thereof is a necessity. Therefore, certain microorganisms in spacecraft should be monitored and the abundance should be in the security line. Conventional detection methods may be not sensitive or do not provide rapid results allowing for immediate action. The quantitative real-time polymerase chain reaction (qPCR) technique has proven to be an effective method to detect and quantify microorganisms in a few minutes. The technique is highly sensitive and able to detect low numbers of microorganisms. However the traditional instrument for PCR does not meet the space requirements that are rapid, portable, and fully automated. In this study, a combined approach of PCR biochip and fluorescence detection camera is developed to isolate and identify the target microorganism. PCR biochip is used to complete the PCR reaction while the camera monitors the product. Stationary and dynamic PCR chips exist depending on whether the reaction mixture flows during the PCR reaction. Advantages and disadvantages of them are listed, and the more adaptive one is used in the study. Finally fluorescent probes are used in the PCR reaction to hybridize with the target sequence to generate a fluorescent signal detected by the camera whose core is an EMCCD, and quantify the amount of PCR product.