Paper ID: 44180
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

Author: Prof. Jongkwang Lee
Hanbat National University, Korea, Republic of

Ms. Seolhui Hwang
Hanbat National University, Korea, Republic of
Prof. Taegyu Kim
Chosun University, Korea, Republic of

FABRICATION AND CHARACTERISTIC OF BLACK BODY SYSTEM WITH NANO-STRUCTURED NEEDLE FOR ON-BOARD CALIBRATION OF IMAGE SENSOR

Abstract

Output characteristics of the satellite infrared (IR) camera are varied according to time elapses and sensor repetition on-off operation. A black body is required to perform periodic calibration for correcting a non-uniformity of the sensor. However, conventional spaceborne black body systems are not accurate enough to perform the precise calibration of image and heavy and bulky. In this study, we proposed a novel black body system for calibration of satellite using MEMS technology. The reflectance of conventional black material such as carbon black is limited to about 20%. One interesting approach to overcome this limit is to use nanostructures. Black silicon(BSi) was selected to form the nano-structured needle. The forest of the nano-structured needle using BSi was developed to improve the optical emissivity for on-board spaceborne blackbody system and to decrease the volume and mass. The forest of nano-structured needle was fabricated on 8 inch silicon wafer using Deep Reactive Ion Etching (DRIE) process. Various process conditions were tested to optimize the fabrication condition. Details of these conditions are C4F8/SF6 = 200/200 sccm, pulse time = 0.5/3 s, process time 5 min, passivation pressure 40 mTorr, etching time from 2 to 4 s, etching pressure from 10 to 60 mTorr, and bottom power from 20 to 100 W. The scanning electron microscopy (SEM) and infrared (IR) spectroscopy were used to evaluate the morphology, aspect ratio, and reflectance of the fabricated nano-structured needle. As a result of the SEM analysis, pressure condition was the most important parameter to form high aspect ratio needle. The best aspect ratio was about 10 at the bottom power 40 W, etching time 3 s, and pressure 10 mTorr. The measured averaged length and width of needle were 2.89 m and 270 nm, respectively. Reflectance measurements also indicated that the proposed black body system can absorb light almost perfectly in the visible spectral range (from 400 to 700 nm). As a result of IR spectroscopy, it was confirmed that a proposed systems is suitable for the black body for correction of the output characteristics of the satellite infrared camera. Furthermore, the next task in broadening reflectance spectral range will focus on applying carbon nanotube (CNT) technology.