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SPECIAL FIBER SENSOR FOR SPACECRAFT APPLICATION

Abstract

Due to the fiber devices have the advantages of light weight, corrosion resistance, aging resistance and easy multiplexing etc, the investigation of optical fiber sensors used in detecting the temperature, strain and other parameters of the spacecraft structure is presented. In this paper, some sensors made from special fibers are used to detect multiple parameters or multiple components at the same time. Moreover, some special optical fibers are studied in our experiments because they can work in the environment of deep irradiation or ultra-high temperature environment.

The optical fiber sensing system here could detect temperature and strain at the same time. To be used in different temperature ranges, the sensors with temperature range between -40 ^{0}C and 300 ^{0}C based on fiber grating, between -40 ^{0}C and 900 ^{0}C based on the fiber taper machine and between 300 ^{0}C and 1800 ^{0}C have been finished respectively.

The optical fiber used under 300 ^{0}C is polyimide coated and the fiber grating is annealing treatment. This kind of fiber sensor had been used widely and the fiber is single mode fiber. The fiber sensor worked under 900 ^{0}C fabricated by a custom-made fiber taper machine. A structural grating is formed by repeatedly tapering. The temperature sensor detecting 1800 ^{0}C make use of sapphire fiber based on the blackbody radiation, but the measurement accuracy is relatively low.

Following the development of aerospace industry, the rocket needs to load more weight and the spacecraft devices in deep space need irradiation resistance. The fiber sensors are applied in the field of structural health monitoring widely. Distributed fiber sensing system gives alarm when the structure under abnormal temperature or strain. Special fiber with the characters of better irradiation resistant capability is welcomed by deep space exploration. Here, we try to fabricate the sensors with the advantages of irradiation resistance. This kind of sensors could detect multiple parameters in deep space.