

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

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STRAIN MEASUREMENT TECHNOLOGY OF THERMAL STRUCTURE IN HIGH TEMPERATURE
ENVIRONMENT**Abstract**

The combustion chamber and tail nozzle of rocket engine always work in non-even thermal environment, so there is great thermal strain which could make elasticity distortion even structure breakage in their internal structure. So the thermal strain of important parts should be measured in ground test. Fiber Bragg Grating is one kind sensor which has several excellent performances such as small volume, series wound measurement, anti-jamming of electromagnetic and soon. Normal FBG sensor is made of quartz fiber by using laser interference stripe in ultraviolet wave. The internal refractive index of fiber is distributed periodically. The Bragg wave length can be changed by strain and temperature in elasticity optics effect and thermal optics effect. The FBG measurement system mainly includes five subsystems which are light transmission system, optics electricity conversion system, data collection system, wave length display system and FBG sensors. The initial wave length of FBG sensors are from 1530nm to 1540nm. The resolution and precision of data collection system is 0.001nm and 0.003nm. The collection frequency is 50Hz. The laser welding process will be used to install FBG sensor when the sample is metallic material, and both sides of FBG sensor should be covered by metal plating. The plasma spraying process will be used to install FBG sensor when the sample is nonmetallic material, and the spraying powder is made of Al₂O₃. The strain response coefficient of FBG sensor is measured by using trapezium cantilever and normal strain gage. The result shows that the average strain response coefficient of FBG sensor is 0.0012nm/, when the strain value is from 0 to 550. There is exact linear relationship between wave length and strain value. The temperature response coefficient of FBG sensor is measured by using infrared radiation equipment. The result shows that the average temperature response coefficient of FBG sensor is 0.0145nm/ when the temperature is from 20 to 1000. There is exact linear relationship between wave length and temperature. In an rocket engine test, the FBG sensors are used to measure thermal strain in many different high temperature areas. The strain value is obtained which is higher than 4000 in 950 area for a short time. And the strain value is obtained which is 1000 in 700 area for a long time.