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MANUFACTURING TESTS FOR FIBER OPTIC SENSORS FOR THERMAL PROTECTION SYSTEMS USING NANOTECHNOLOGY

Abstract

In the paper it will be presented original work aimed to demonstrate the feasibility of manufacturing fiber optic sensors for temperatures up to 2000 C. A possible application for this type of sensor is for structural health monitoring of thermal protection systems of reusable space vehicles. Another application can be for monitoring hot parts of space motors. It is several years now that fiber optic sensors are used for monitoring several parameter such as strains and temperatures. The advantages of those sensors with respect to the conventional ones are many. They are small (150 microns in diameter or less), easily embeddable, light, immune from electromagnetic interferences, to mention just a few. However the main limitation for this type of sensors is the temperature range. Typically those sensors can be used up to 500 C, even if recently special type of those sensors can reach temperature as high as about 800 C. The most used fiber optic sensors are the so called Fiber Bragg Gratings (FBGs). Those sensors are obtained by changing on the fiber core the index of refraction using the interference pattern of coherent ultraviolet light. Conventional optical fibers used in telecommunications are made of silica with melting temperatures of about 1050 C. In case of ultra high temperatures it is required to use sapphire fibers which withstand temperatures up to 2000 C. They have a high transmission loss but in few meters the optical signal maintain sufficient intensity. Tests have been performed to measure the sensitivity of sapphire to synchrotron light. Also micro grooves have been manufactured using ion beam. Numerical simulations have also been performed to predict the bandwidth of the reflected signal from the FBGs. Several parameters have been changed such as fiber diameter, effective index of refraction and number of micro grooves (length of the FBG sensor).