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MATERIALS SURFACE EMISSIVITY ANALYSES PERFORMED BY THE COMBINED USE OF DUAL AND SINGLE COLOR OPTICAL PYROMETERS

Abstract

The experimental determination of spectral emissivity of the surface of materials for thermal protection systems of re-entry vehicles in the Earth's atmosphere has always been a target during tests in the hypersonic plasma ground simulators. By this way, the application of non-intrusive optical devices, such as infrared pyrometers able to measure the surface temperature, makes possible the evaluation of emissivity of the surface of tested materials at different temperature values. The combined use of different types of pyrometers makes possible the emissivity evaluation by means of the comparison between the temperature values measured by dual color pyrometers and single color ones. By this way, some preliminary experiments was performed in air and at ambient pressure on metallic samples: optical pyrometers of dual color type and single color one, at different wavelengths, have been used to measure surface temperature and then to obtain values of spectral emissivity. In particular, samples of OFHC Copper and stainless steel AISI-316L were installed on a quartz beam and then inserted inside the graphite spherical cavity of a black body in the temperature range from 500C to 1000C. Moreover a K-type thermocouple installed in the sample through the quartz beam, was used during the tests in order to obtain an independent measurement of the sample temperature. In the case of copper-based sample the oxidation of the surface during the test has been observed with the formation of a grey surface scale. Thermogravimetric analysis (TGA) performed in air on a fraction of that corrosion scale has excluded the presence of graphite allowing to confirm that the cavity of black body is not able to contaminate the surface of tested samples by releasing of graphite gaseous during tests. By combining the temperatures measured by the pyrometers and the thermocouple the spectral emissivity of the samples as function of temperature at three different wavelengths has been determinated. Moreover, the agreement between the experimental emissivity determinated and the emissivity values reported in literature has been verified.