THE PARAMETERS AFFECTING ON THE DESIGN AND PERFORMANCE OF INFRARED BLACKBODY – A REVIEW

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***Abstract*:** A blackbody is used for calibration of radiometers and infrared systems in many applications. A technical blackbody design by considering various parameters which directly affect the design and performance of blackbody. This review main aim to find out various cavity shape of blackbody, black paint and various emissivity measurement technique. In this selection of blackbody cavity shape, black paint selection for improve emissivity of blackbody, material of blackbody and other parameters affect the design and performance of blackbody are presented.

Keywords: blackbody, infrared, calibration source, design, performance, parameters

I. INTRODUCTION

An ideal blackbody is physical body which absorb all incoming electromagnetic radiation on the body surface. In case of blackbody no reflected radiation and no transmitted radiation all incoming radiation is absorbed by blackbody surface. Near, isothermal condition blackbody emit all radiation according to Planck 's law.

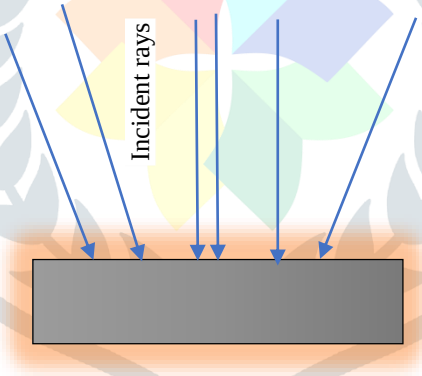

Fig.1 Concept of ideal Blackbody

In above figure concept of ideal blackbody is presented. Blackbody absorb all incoming radiation on it and in isothermal condition emit all radiation according to Planck's law.

II. LITERATURE REVIEW

S. Scheiding, H. Driescher et al. [1] In this paper, different geometries are analyzed, and the production methods are discussed. The mercury radiometer and thermal infrared spectrometer (MERTIS) calibration source MBB3, MBB7 and its shape, size and emissivity value for spectral range from 10µm to 40µm are presented. The author is concluded that by using this type calibration devices for in flight calibration of space borne infrared instruments an absolute measurement and the comparability of different results over time and over various devices are achieved.

Lian Xue et al.[2] This paper gives the details of low temperature surface blackbody which works under vacuum and low temperature environment, control with liquid nitrogen and electric heating in 130K to 450K temperature range. It is also give a detailed related to structure of blackbody, temperature control system, design of radiator. By experiment and analysis achieve good temperature uniformity across blackbody surface, temperature stability performance, and is able to provide a benchmark of low temperature infrared system.

Friedhelm Olschewski et al. [3] In this paper the design and performance of the balloon-borne blackbody (BBB) is presented. 126mm × 126mm array blackbody consists pyramids with groove shape unite design. Blackbody is made from Al material. PCM material used for heating and cooling of blackbody. Temperature uniformity, temperature stability and effective emissivity is main performance parameters of blackbody. by experiment obtain 0.9996 emissivity of blackbody.

Anne Kleinert et al. [4] In this paper, study the required uncertainty of radiation standards to properly resolve decadal trends of climate-relevant trace species like ozone, water vapor, and temperature distribution for the Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA). Temperature non uniformities of the onboard reference blackbodies, used for radiometric calibration, have an impact on the calibration uncertainty. The propagation of these non-uniformities through the retrieval is analyzed. A threshold for the maximum tolerable uncertainty of the blackbody temperature is derived, so that climate trends can be significantly identified with GLORIA.

R. Karoli et al. [5] In this paper, honeycomb shape cavity blackbody performance characteristics and test results under vacuum condition are presented. A blackbody is operating between -40°C to +60°C, utilizing thermoelectric heat pumping for uniform and stable temperature control. Honeycomb shape cavity array is located by temperature regulated baffle system, produce a high emissivity (> 0.995) with the minimum temperature gradient across the array of blackbody in vacuum condition. In this also used heating and cooling arrangement to maintain uniform temperature across the blackbody array and this two are controlled by proportional regulators.

Hyun-Ung Oh et al. [6] On-board black body is used for radiometric calibration of space borne infrared (IR) radiometers and imaging systems. The black body is equipped with heaters to heat up the black body during imaging for calibration, a heat pipe to transfer residual heat on the black body just after the black body heating to radiator on the spacecraft (S/C), and embedded temperature sensors to measure the black body surface temperature has been proposed and manufactured. The characteristic of black body under on-orbit conditions has been predicted by numerical simulation using a correlated thermal model obtained from ambient test results. In this paper, Emissivity test results indicate that the BB design with V grooves and velvet coating on the BB surface is adequate to meet the requirement of 0.99. Black body heat-up testing has also been performed in an ambient thermal chamber. To predict the characteristics of BB under an on-orbit environment, numerical simulation under vacuum conditions using a highly accurate correlated thermal model with ambient test data has been performed.

J. P. Rice etl [7] In this paper working of TXR, radiance temperature measurement of blackbody using TXR and calibration of TXR are presented. By using TXR easily find out the radiance temperature of blackbody in vacuum condition.

Devyn Monte maranol et al. [8] In this paper, use the infrared camera to study the emissivity, the ability to emit radiation, of different materials in order to find the best surface coating for improving the radiation cooling and heating mechanisms of energy saving structures. Because emissivity is different for each material, for instance, carbon soot has a higher emissivity than aluminium foil, the infrared camera cannot detect the correct temperature of multiple materials simultaneously.

Hyun-Ung Oh et al. [9] Blackbody is used for radiometric calibration of IR radiometers and infrared systems. In this paper two different arrangement of heat pipe and heaters are used in thermal design. Heaters are used to heat up blackbody from low to high temperature and heat pipe for transfer heat from blackbody to radiator. In thermal design effectiveness of this two design is investigated by on orbit thermal analysis of blackbody. The author is concluded that the both thermal design maintain the uniform temperature across the blackbody surface but second one blackbody give the good performance.

Adibekyan et al. [10] In this paper, emissivity measurement detail of different coatings: Nextel 811-21, Herberts 1534, Aeroglaze Z306 and Acktar Fractal Black are given in wide wavelength range from 4μm to 100μm and in various temperature condition. The conclusion is Nextel 811-21 give the high emissivity compare to other black coating in various condition. The achieved absolute standard uncertainty (k = 1) is calculated according to It is 0.005 or better for measurements at high temperatures (T = 120°C and T = 150°C) and it is better than 0.022 (for some measurements better than 0.011) for measurements at 25°C. It should be noted that the achieved uncertainty significantly depends on the experimental conditions and the investigated coating.

M. J. Persky [11] In this paper, Low reflectivity ‘‘black’’surface treatments for space-borne infrared systems are reviewed. The uses of black surfaces in general, as well as for specific space-borne applications are discussed.

III. CONCLUSION

From the literature review observed that many shapes of blackbody are used in many applications. Al material used for good surface finish and good thermal conductivity of blackbody. various black paint coating is used for achieve required emissivity of body. TRT (transfer reference radiometer), IR camera used for temperature and emissivity measurement of IR blackbody.

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