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Title

Heat flux measurement during short run-time shock-tube experiments

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Abstract

The heal flux is an essential part of the development of high-speed flight vehicles and re-entry bodies. Till now the CFD simulation of the heat flux to the surface of a body is a complicated and not-error-free part of the engineering process of the vehicles constriction.

For the validation process a ground experiment to check applicability of the physical model and mathematical formulation used in CFD is needed. And for the low enthalpy flow in can be done using a long-time facilities where heat flux measurement developed for many years and not a problem now, for the high enthalpy flow such measurements a complicated task. It the report a applicability of different types of heat flux measurements in shock-tube facilities with 10 us – 1 ms work time will be presented.

A shock tube is a standard instrument for the relatively low-cost ground experiment and for chemical kinetics study. The advantage of the shock tube is a possibility to create large temperatures and flow enthalpies but only for the short time.

In the report two types of sensors used in Ioffe institute shock-tube experiments will be presented. The first type is a thermoelectric heat flux sensor, the sensitive element of the sensor is a thin film of artificially anisotropic chromium obtained by oblique deposition on a high-resistance silicon substrate. This technology is used in laser systems to measure the power of laser radiation. And the second one is a heat flux sensor based on anisotropic bismuth thermoelements or a heterogeneous copper-nickel structure.

It is shown that such types of sensors can be used in a short-type high-enthalpy experiments. The calibration of the sensors (the volt-watt coefficient) can be recovered using the shock tube experiments with reflected shock waves.

In the report the data on sensors, procedure of the calibration and some experimental data with models of non-complicated geometry will be presented.

References

[1] Popov,PA; Monakhov,NA; Lapushkina,TA; Poniaev,SA; Kurakin,RO Calibration of heat flux sensors based on anisotropic thermoelements and heterogeneous metal structures using a reflected shock wave. Tech. Phys. Lett., v.48, 10, 2022, p. 46 – 48 https://dx.doi.org/10.21883/TPL.2022.10.54798.19297

[2] Kotov,MA; Shemyakin,AN; Solovyov,NG; Yakimov,MY; Glebov,VN; Dubrova,GA; Malyutin,AM; Popov,PA; Poniaev,SA; Lapushkina,TA; Monakhov,NA; Sakharov,VA Performance assessment of thermoelectric detector for heat flux measurement behind a reflected shock of low intensity. Appl. Therm. Eng., v.195, 2021, ArtNo: #117143 http://dx.doi.org/10.1016/j.applthermaleng.2021.117143