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A NEW DEVICE AND METHOD FOR SIMULATING HYPERSONIC AEROTHERMAL ENVIRONMENT

Abstract

When flying at hypersonic speed, aircraft will face severe aerodynamic heating. Its surface material must go through the aerothermal ablation test which is close to the actual flight before it can be used. The key of the test is to create an equivalent aerothermal environment on the ground. At present, the main methods used to simulate the aerothermal environment are quartz lamp heating, oxyacetylene premixed flame ablation, engine exhaust and high enthalpy wind tunnel. The high enthalpy wind tunnel can establish the aerothermal environment closest to the actual state, but the experimental cost is too high, and some parameters can not meet the conditions. In this paper, the test simulation methods of aerothermal environment are summarized, and a more accurate similarity criteria of test parameters is proposed through the analysis of experimental parameters. In the criteria, when it is difficult to guarantee the same recovery enthalpy and cold-wall heat flow at the same time, it is necessary to take the equal hot-wall heat flux as the basic principle, and then the recovery temperature of test gas should be adjusted according to the convective heat transfer coefficient under ground test conditions, so as to meet the test requirements. This paper also proposes a new type of aerothermal environment simulation device, which has the characteristics of simpler operation, lower cost and simpler parameter adjustment. Material ablation experiments in hypersonic flight environment were carried out using the method and equipment proposed in this paper. The experimental results are close to those of arc wind tunnel test. This shows that the proposed test device and parameter similarity method can not only simulate the high temperature aerothermal environment, but also broaden the parameters range of the test simulation, and provide a guarantee for the heat transfer and ablation test research of thermal insulation materials in the high temperature aerothermal environment.