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STUDY ON ULTRA-TEMPERATURE, HIGH HEAT FLUX, NONLINEARITY AERODYNAMIC HEATING ENVIRONMENT SIMULATION AND THERMO-MACHANICAL TESTING TECHNIQUE

Abstract

Experiment simulation technique for ultra-temperature, high heat flux and nonlinear aerodynamic thermal environment and corresponding extreme high temperature environment mechanical testing techniques are the key point in the design of hypersonic vehicle thermal protection material and structure safety, which is related to the success or failure of vehicle development. Principles and capability of a self-developed quartz lamp infrared radiation-based aerodynamic heating simulation system is introduced in this paper. This system is capable of producing nonlinear dynamic thermal shock process with a heat flux of 2MW/m2, heating rate up to 210 oC/s, and highest temperature up to 1500oC. A number of experiments were performed based on the self-developed heating simulation system. These experiments include but not limited to: (1) new method of insensitive to ambient light change active imaging digital image correlation was proposed. By using non-contact optical metrology, full-field high-temperature deformation can be measured up to 1550oC. (2) fracture property testing of composite material SiC/SiC specimen in thermal environment up to 1400oC was accomplished. This aerodynamic heating simulation system and mechanics testing methods have great military engineering application values in the design of hypersonic flight vehicle and aerospace and aeronautics fields.