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The Temperature Measurement of High Speed and High Enthalpy Gas

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In order to investigate the aerothermochemical interactions between graphite and high speed and high enthalpy flow, a plasma jet wind tunnel has been constructed.

The purpose of this investigation is to measure the temperature distribution of the argon plasma jet.

The temperature of the plasma jet is the important characteristic to know the plasma jet. The mean temperature of the plasma jet can be derived from the input energy and the thermodynamic properties of the gas constituting the plasma jet. But, as there is a large temperature gradient along the radius and the axis of the plasma jet, it requires to measure the temperature distribution in order to know the property of the plasma jet.

As the working gas, argon is used. Argon is heated by the arc between the electrode and the cathode, and after enters in the plenum chamber argon is erupted in the plasma wind tunnel through the Laval nozzle.

The temperature distribution in the plasma jet was determined by the relative intensity method of spectral lines using a spectrograph, and the radiation intensities of spectral lines dispersed by the spectrograph was measured by the oscillograph as the output of a multiplier phototube.

The measured temperature increases with the input energy from 3900 kW at 3.5 Kw to around 5500°K at 9.25 kW, for both of the flow rate considered, and decreases along the flow axis from 4700°K at nozzle exit to 3600°K at 20 mm down stream of the nozzle exit.

The measured temperature is compared with the value obtained from the aerodynamic relation. The difference between the measured temperature and the calculated value is about 1700°K.

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