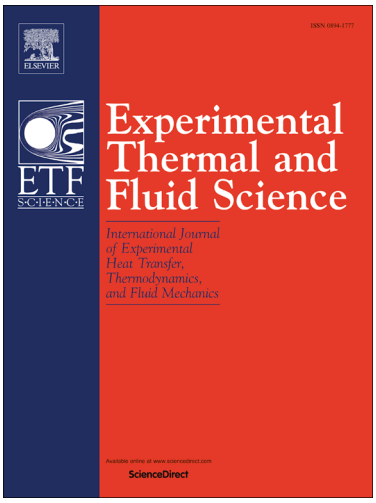

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Experimental study of heat transfer in rarefied gas flow in a circular tube with constant wall temperature

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Abstract

This paper presents an experimental study of heat transfer in a slightly rarefied gas flowing in a circular tube with constant wall temperature boundary condition. Local temperature measurements are carried out for the first time in rarefied gas flows to investigate into the anomalous values of Nusselt number (*Nu*) obtained by a previous experimental study (Demsis et al. 2009). The present measurements agree well with the low *Nu* reported by Demsis et al. (2009) when the *Nu* is obtained using their procedure; additionally, the measurements reveal the importance of end effects in determining the Nusselt number in rarefied gases. The Nusselt number obtained in the present experiments tends to zero with increasing axial conduction. *Nu* shows a weak dependence on Knudsen number for the range investigated here ($0.001 < Kn < 0.012$).

1. Introduction

Heat transfer in an incompressible fluid flowing in a circular tube with constant wall temperature has been well documented in the laminar continuum regime. It is well known that under such conditions, for a fully developed flow, the Nusselt number is a constant (*Nu* = 3.65). However, the heat transfer in rarefied gas is not very well understood. In such flows, the Knudsen number (*Kn*) becomes significant and temperature and velocity jumps at the wall become important. Although there are a lot of theoretical and simulation studies concerning heat transfer in rarefied gas flows, there is considerable lack of experimental data on the subject.