Experimental analysis of heat transfer between a heated wire and a rarefied gas in an annular gap with high diameter ratio

H. Chalabi[1], **O. Buchina**[2], **L. Saraceno**[3], **M. Lorenzini**[1], **D. Valougeorgis**[2], **G.L. Morini**[1]

[1]DIENCA-Alma Mater Studiorum Università di Bologna, Bologna, IT
[2]University of Thessaly, Department of Mechanical Engineering, Volos, GR
[3]ENEA, ITFD Casaccia, Rome, IT

E-mail: gianluca.morini3@unibo.it

Abstract

In this paper a first experimental attempt is performed to measure heat conduction through rarefied air at rest contained between two concentric cylinders. The heat transfer between a heated platinum wire having a diameter (d) of 0.15 mm, disposed along the axis of a cylindrical shell in stainless steel having an inner diameter (D) of 100 mm, and a surrounded rarefied gas has been studied experimentally and numerically. The ratio between the outer and inner diameter of the annular region filled by the gas is large (D/d=667). In the annular region filled with air the pressure was varied by using a vacuum pump from atmospheric value down to 10^{-3} mbar. Temperature differences between the wire and the external stainless steel wall in the range 50-125 K were imposed and the heat power transferred from the wire to the surround was measured as a function of the gas pressure starting from air at atmospheric conditions down to 10^{-3} mbar. The experimental results obtained in these tests were compared with the numerical results obtained by using the linear and nonlinear Shakhov kinetic models.