Motion of an array of plates in a rarefied gas caused by radiometric force

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Abstract

We consider an infinitely long two-dimensional channel containing a rarefied gas. Inside the channel, there is an array of infinitely many two-dimensional plates (with finite width and without thickness) perpendicular to the axis of the channel, and the array can move freely along the channel. If one side of each plate of the array is heated and the other side is not, it is subject to a force because of the temperature difference on its two sides (radiometric force). In consequence, the array starts moving, and finally its motion reaches the steady motion with a constant velocity, where the radiometric force and the drag force acting on each plate counterbalance. We investigate the behavior of the gas in this final steady motion and obtain the speed of the array numerically on the basis of kinetic theory, for a wide range of the Knudsen number. The present problem can be regarded as a simplified model for the moving vanes of the Crookes radiometer.