

Friction Induced Fluid Heating in Nanochannel Flow

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We investigate the mechanism of friction induced fluid heating under the influence of surfaces. The temperature distributions of liquid argon and helium in nanoscale Poiseuille flows are studied through molecular dynamics simulations. It is found that the fluid heating is mainly caused by the viscous friction in the fluid when the external force is small and there is no slip at the fluid-solid interface. When the external force is larger than the fluid-surface binding force, the friction at the fluid-solid interface dominates over the internal friction of the fluid and is the major contribution to fluid heating. An asymmetric temperature gradient in the fluid is developed in the case of unidentical walls and the general temperature gradient may change sign as the dominant heating factor changes from internal to interfacial friction with increasing external force. The effect of temperature on the fluid heating is also discussed.