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COMMENTS

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Comment on “Stress-density ratio slip-corrected Reynolds equation for ultra-thin film gas bearing lubrication” [Phys. Fluids 14, 1450 (2002)]

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The stress-density model proposed in the paper¹ was presented and verified by numerical simulations in an earlier paper.² Specifically, Morris, Hannon, and Garcia² performed both molecular dynamics and direct simulation Monte Carlo (DSMC) simulations of Couette and Poiseuille flow and measured slip length (referred to as the coefficient of slipping, G , in Ref. 1) at high Knudsen number. Morris *et al.* found that if $\text{Kn} < 0.1$ then $G \approx \lambda_h$, where λ_h is the mean free path evaluated from the collision cross section. The slip length was observed to be significantly smaller than λ_h at higher Knudsen number; this result was verified recently by Wijesinghe and Hadjiconstantinou.³ Most importantly, Morris *et al.* proposed approximating the slip length as $G = \alpha \lambda_v$ where λ_v is the mean free path evaluated from the viscosity.⁴ When the effective viscosity is obtained from the

wall shear stress they found that $\alpha \approx 1$ for a wide range of Knudsen number. Ng *et al.* performed DSMC simulations of slider bearing flow, which is a composite of Couette and Poiseuille flow.⁵ Since their simulations are performed at $\text{Kn} \approx 1$, they also observe that $G < \lambda_h$. Comparing Eqs. (1)–(4), (7) and (10) in Ref. 2 with Eqs. (4), (6), and (7) in Ref. 1 shows that the stress-density model is equivalent to $G = \lambda_v$.

¹ E. Ng, N. Liu, and X. Mao, “Stress-density ratio slip-corrected Reynolds equation for ultra-thin film gas bearing lubrication,” *Phys. Fluids* **14**, 1450 (2002).

² D. Morris, L. Hannon, and A. Garcia, “Slip length in a dilute gas,” *Phys. Rev. A* **46**, 5279 (1992).

³ H. Wijesinghe and N. Hadjiconstantinou, “Velocity slip and temperature jump in dilute hard sphere gases at finite Knudsen numbers,” *Proceedings of the First MIT Conference on Computational Fluid and Solid Mechanics*, 2001, Vol. 2, p. 1019.

⁴ C. Cercignani, *The Boltzmann Equation and its Applications* (Springer-Verlag, New York, 1988).

⁵ S. Fukui and R. Kaneko, “Analysis of ultra-thin gas film lubrication based on linearized Boltzmann equation,” *ASME J. Tribol.* **110**, 253 (1988).

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