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Effective Viscosity of Confined Hydrocarbons

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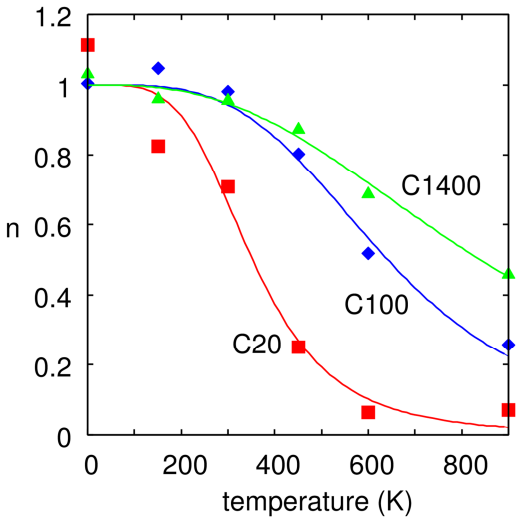
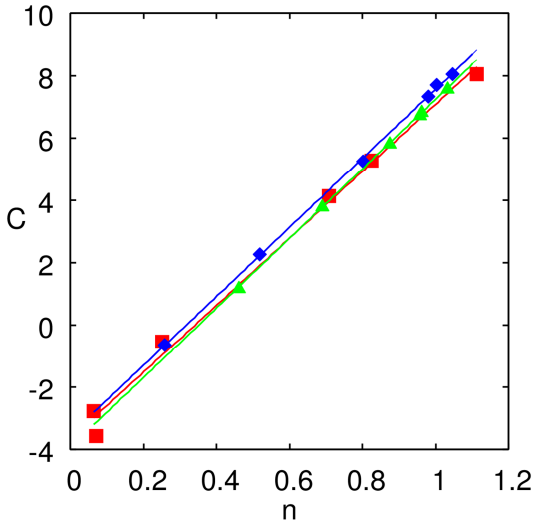
We present Molecular Dynamics (MD) friction calculations for confined hydrocarbon films with molecular lengths from 20 to 1400 carbon atoms. We find that the logarithm of the effective viscosity η_{eff} for nanometer-thin films depends linearly on the logarithm of the shear rate γ: $\log_{10}\eta_{eff}=C-n\log_{10}\gamma$, where n varies from 1 (solid-like friction) at very low temperatures to 0 (Newtonian liquid) at very high temperatures, following an inverse sigmoidal curve. Only the shortest chain molecules melt, whereas the longer ones only show a softening in the studied temperature interval 0 < T < 900 K. The results are important for the frictional properties of very thin (nanometer) films and to estimate their thermal durability. The results are in good accordance with the outcome of Surface Force Apparatus experiments (see e.g. Yamada S. Trib Lett, 13 (3), p 167, 2002)

Figures: Factor n as a function of temperature for three molecule lengths and factor C as a function of n for all investigated systems.





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