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Molecular diffusion and tensorial slip at surfaces with periodic and random nanoscale textures NIKOLAI PRIEZJEV, Michigan State University — The influence of periodic and random surface textures on the flow structure and effective slip length in Newtonian fluids is investigated by molecular dynamics (MD) simulations. This study is motivated by the possibility to generate transverse flows in microfluidics devices to enhance mixing and separation processes. We consider a situation where the typical pattern size is smaller than the channel height and the local boundary conditions at wetting and nonwetting regions are characterized by finite slip lengths. In case of anisotropic textures, the interfacial diffusion coefficient of fluid molecules near heterogeneous surfaces correlates well with the effective slip length as a function of the shear flow direction with respect to the texture orientation. In addition, it was found that the angular dependence of the effective slip length obtained from MD simulations is in good agreement with hydrodynamic predictions provided that the pattern size is larger than several molecular diameters. These findings lend support for the microscopic justification of recently introduced tensor formulation of the effective slip boundary conditions in the case of noninertial flows of Newtonian fluids over smooth surfaces with nanoscale anisotropic textures.
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