Combined Effects of Geometrical Confinement and Interaction Anisotropy on Nanofluid Thermal Conductivity

Koki UDA [1], Takahiro IKEDA [2,3], Yusei KOBAYASHI [3,4], Masashi YAMAKAWA [3,4]

[1] *Graduate School of Science and Technology, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku 606-8585, Kyoto, Japan*
[2] *Center for the Possible Futures, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku 606-8585, Kyoto, Japan.*
[3] *High-Performance Simulation Research Center, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku 606-8585, Kyoto, Japan.*
[4] *Faculty of Mechanical Engineering, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku 606-8585, Kyoto, Japan.*

koukoukou0308@gmail.com

Nanofluids, created by suspending nanoparticles in a liquid, offer transformative potential for high-efficiency thermal management. While the impact of surface interaction anisotropy on thermal transport is well-documented in bulk phases, the behavior under nanoscale confinement remains an open question. This study employs molecular dynamics simulations to investigate the thermal conductivity of copper-argon nanofluids confined within a slit-like nanochannel.
We systematically explore the complex interplay between the degree of surface anisotropy and the channel width. Our analysis focuses on how the spatial constraints imposed by the walls modulate the diffusive dynamics and the local environment surrounding the nanoparticle.
Preliminary observations suggest that the influence of surface anisotropy on heat transport is significantly coupled with the confinement scale. By integrating dynamic properties with a detailed characterization of the liquid phase, we aim to clarify the mechanisms that determine the overall thermal conductivity in these restricted geometries. This study provides a fundamental framework for understanding energy relaxation in confined anisotropic systems and discusses the potential for tailoring nanoscale thermal properties in future fluidic applications.

Keywords:
Nanofluid, Janus Particle, Confined liquid, Molecular dynamics

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