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Rheological Characteristics of Nanofluids and Their Impact on Heat Transfer Performance

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Abstract

Nanofluid rheology plays a crucial role in determining their thermal transport performance and practical applicability in heat transfer systems. The presence of nanoparticles alters the fluid's viscosity and flow behavior, often resulting in complex non-Newtonian characteristics such as shear-thinning or shear-thickening. This paper investigates the fundamental mechanisms governing these rheological changes, focusing on nanoparticle interactions, Brownian motion, and dynamic aggregation. The interplay between altered flow resistance and convective heat transfer is analyzed, highlighting how rheological properties influence boundary layer development and thermal mixing. Understanding these relationships is essential for optimizing nanofluid formulations to achieve enhanced heat transfer while maintaining manageable flow characteristics for engineering applications.

Key words: Nanofluids, Viscosity, Shear-thinning, Shear-thickening, Brownian motion, Heat transfer enhancement, Convective heat transfer