Thermo-Physical Properties of Hybrid Nanofluids and Hybrid Nanolubricants: A Comprehensive Review on Performance


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Hybrid nanofluids and hybrid nanolubricants are very new types of research which can be prepared by suspending two or more than two dissimilar nanoparticles either in a mixture or composite form in the base fluids. The term hybrid can be considered as different materials which are a combination of physical and chemical properties to form a homogeneous phase. The main objective of synthesizing hybrid nanofluids/nanolubricants is to improve the properties of single materials where it has great enhancement in thermal properties or rheological properties that are better than individually conventional nanofluids/nanolubricants.

This review summarizes the previous research on the thermo-physical properties of hybrid nanofluids/nanolubricants including methods of preparation, instrumentations, development and current progress, and hybrid performance in terms of heat transfer and pressure drop. Challenges and several applications using hybrid nanofluids/nanolubricants were also discussed. Recent studies showed that the hybrid nanofluids/nanolubricants improved the performance of the single type suspended nanoparticles. Various studies of hybrid nanofluids have been carried out to investigate the heat transfer performance and thermal conductivity; however, other thermo-physical properties such as viscosity, density and specific heat have been neglected. In addition, few studies on hybrid nanolubricants were done only for thermo-physical properties. Thus, a comprehensive study on heat transfer and the other thermo-physical properties are necessary to show the potential of hybrid in engineering applications.