Modified Bruggeman Model for the Effective Thermal Conductivity of Particulate Composites with Interfacial Thermal Resistance

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In recent years, significant research efforts have been devoted to study the thermal properties of nanofluids [1], given their importance in an increasing variety of technological applications. The effects of microstructural characteristics in these composite systems play a determinant role on their macroscopic properties; however to date, the understanding of these effects is not well established. Experimental results have shown that the interfacial thermal resistance has an important effect on the thermal conductivity of the composite systems. In this work, combining the well known Bruggeman theory [2] and Nan et al. results [3], formulas for predicting the effective thermal conductivity of anisotropic particulate composites with interfacial thermal resistance are derived. The developed equations are valid for a composite material containing arbitrarily oriented ellipsoidal particles with any aspect ratio and they can be expected to be suitable mainly for large volume fractions, when the thermal interaction between neighboring particles needs to be considered. Results of the present approach are reduced to simpler formulas for some limiting cases in the particle shape. The comparison between already published experimental data and the predicted results for the case of covered spheres shows good agreement. In addition, the graphical simulations of the effective thermal conductivity for different composites show reasonable behaviors with the particle shape and size as well as with the thickness particle covering layer.

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