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Quantifying the properties of nano-composites. MURRAY DAW, BO ZHANG, JIAN HE, TERRY TRITT, Clemson University — With the proliferation of nano-composites produced for possible thermoelectric application, we ask the question: To what extent is a given nano-composite like other composites? Or, in other words, when do we know that we have something new? To address this we apply the classical theory of composites to specific nano-composites grown and characterized at Clemson. The theory is very simple and assumes explicitly very simple properties of the materials, the most important being Fourier's Law/Ohm's Law. Given this assumption, the theory of composites can be applied to the nano-composites based on what is known of the microstructure. This "classical" result then forms the basis by which the properties can be compared to determine if non-classical effects are being observed. One simple theory is the application of rigorous bounds, such as the Hashin-Strikman Bounds which are based only on very simple microstructural descriptors. Another simple theory is the application of FEM, which can be constructed directly from SEM images of the samples using the NIST code "OOF". The FEM produces specific predictions for the composite properties. We find that the Hashin-Strikman Bounds are very useful for analyzing the thermal conductivities of composites, but are too loose to be useful for low-temperature electrical conductivity of composites composed of metals and insulators, where the FEM technique can be applied successfully.

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