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Modular assembly of binary nanocrystal composite solids for high-efficiency thermoelectric power generation DONG-KYUN KO, University of Pennsylvania, Materials Sci. & Eng., CHRISTOPHER MURRAY, University of Pennsylvania, Materials Sci. & Eng. and Chemistry — Despite the numerous advantages of semiconductor nanostructures, doping nanometer size crystals show difficulties not found in conventional bulk systems. Especially for thermoelectric applications, it is critical to control the number of carriers that are available in semiconductors in order to maximize the figure of merit. Here, we report modular assembly of binary composite nanocrystals, as an effective bottom-up design tool, to create a new family of artificial solids with a prescribed set of doping levels. Silver telluride (Ag2Te) nanocrystals, which can act as dopants, are introduced in lead telluride (PbTe) nanocrystal assemblies in order to modify the carrier concentration until an optimum power factor is realized. This study focuses on electronic and thermoelectric characterization of these binary composite solids. Hall measurement and field effect transistor characteristics were investigated in order to identify the carrier type, mobility, and concentration. Temperature dependence of low-bias conductivity was also characterized to gain a better understanding of electronic conduction. Finally, Seebeck voltage was measured with varying PbTe to Ag2Te nanocrystal concentration ratios in order to investigate the Seebeck coefficient as a function of carrier concentration.

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