Supporting Information for

Low-temperature thermoelectric power factor enhancement by controlling nanoparticle size distribution

Mona Zebarjadi, Keivan Esfarjani, Zhixi Bian and Ali Shakouri

Scattering rates:

In the following, we compare room temperature momentum scattering rates for two samples discussed in the manuscript. Both samples are made of GaAs. The first one is impurity-doped and the second one is nanoparticle-doped. The nanoparticle-doped sample contains 5% of uniform nanoparticles with the radius of 1nm and barrier height of 0.2eV. GaAs material parameters are set according to the literature[1] and are listed in table S1. The thermoelectric power factor is maximized versus the Fermi level for each sample. The plotted rates in fig. S1 and S2 are calculated at the optimum Fermi level of each sample. Note that in the presence of nanoparticles, phonon rates modify slightly since nanoparticles change the effective band structure.

Table S1. GaAs material parameters used in the calculations

Material Parameters:	
Effective mass (Γ valley)	$0.063m_0$
dielectric constant (static)	12.9
dielectric constant (high frequency)	10.89
Density	5.317 g cm^{-3}
Sound velocity	5.22 x10^5 cm/s
Polar optical phonon energy	0.03536 eV
Acoustic deformation potential	7 eV

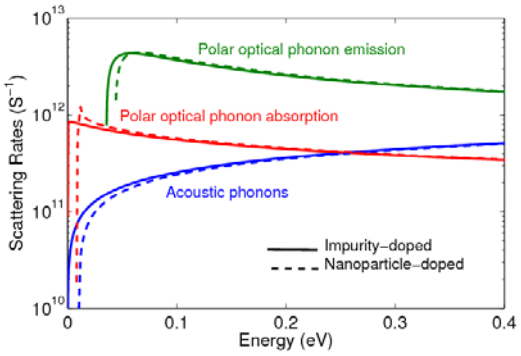

Fig. S1. Electron-phonon momentum scattering rates for the two samples. Solid lines are calculated for impurity-doped sample and dashed lines are calculated for nanoparticle-doped sample.

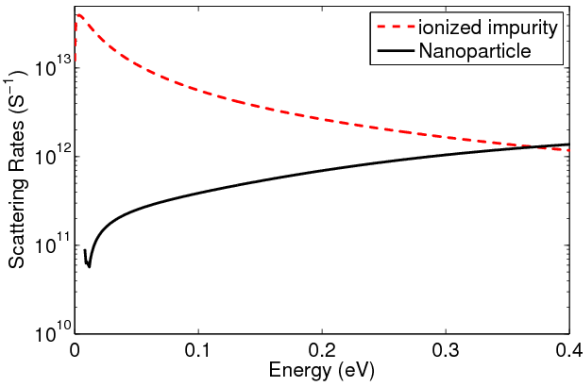

Fig. S2. Impurity scattering rates and nanoparticle scattering rate for the two samples. Each rate is calculated at the optimum Fermi level of the relevant sample.

As can be seen from Fig. S2., In the study case, nanoparticle scattering rate is much smaller than the impurity scattering rate, which results in higher mobility for the nanoparticle-doped sample.

[1] Ioffe Physico-Technical Institute, http://www.ioffe.rssi.ru/SVA/; Landolt-Börnstein online data base; http://www.springer.com/west/home/laboe?SGWID=4-10113-0-0-0