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Effect of phonon-blocking at sintered interfaces[1]

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With an aim to develop high figure-of-merit silicon nanocrystalline thermoelectrics, controllability of thermal conductivity is demonstrated by combining computation, measurement, and material synthesis. Direct measurements of interfacial thermal conductance at sintered interfaces using a 2D model interface reveal that the interfacial thermal conductance can be greatly reduced by precipitating silicon oxide crystalline nano-dots at the interface. Furthermore the impact of the reduction in interfacial thermal conductance on the overall thermal conductivity of the bulk nanocrystalline material is identified by multiscale phonon transport calculation using intrinsic phonon properties obtained from first principles. These analyses help us identify the required interfacial structure and grain size (mean value and distribution) for a target thermal conductivity. Attempts to implement this in the actual material development will be also introduced.

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