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Enhancement of Thermoelectric Figure-of-Merit by a Nanostructure Approach ZHIFENG REN, Boston College, BED POUDEL, GMZ Energy, Inc., YI MA, YUCHENG LAN, XIAOWEI WANG, GIRI JOSHI, GAOHUA ZHU, JIAN YANG, BO YU, XIAO YAN, HUI WANG, DEZHI WANG, Boston College, QING HAO, HOHYUN LEE, AUSTIN MINNICH, ANDREW MUTO, DARYOOSH VASHAEE, MILDRED DRESSELHAUS, GANG CHEN, MIT, BOSTON COLLEGE TEAM, GMZ ENERGY INC. TEAM, MIT TEAM, NANJING UNIVERSITY COLLABORATION, MIT COLLABORATION — The dimensionless thermoelectric figure-of-merit (ZT) in bulk materials has remained about 1 for many years. Here we show that a significant ZT improvement can be achieved in nanocrystalline bulk materials. These nanocrystalline bulk materials were made by hot-pressing nanopowders that are ball-milled from either crystalline ingots or elements. Electrical transport measurements, coupled with microstructure studies and modeling, show that the ZT improvement is the result of low thermal conductivity caused by the increased phonon scattering by grain boundaries and defects. More importantly, the nanostructure approach has been successfully applied to a few thermoelectric material systems, proving its generosity. The approach can be easily scaled up to multiple tons. Thermal stability studies have shown that the nanostructures are stable at the application temperature for an extended period of time. It is expected that such enhanced materials will make the existing cooling and power generation systems more efficient.

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