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An Overview of Recent Progress in Thermoelectric Materials Research

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In the past year there have been two significant breakthroughs in thermoelectric materials research on bulk materials. The best thermoelectric figure of merit near room temperature has been increased by more than 50%. Two groups have demonstrated room temperature values for ZT near 1.5. As was first found in carefully prepared thin films, the increase in ZT in nanocomposites is almost entirely due to a decrease in the lattice thermal conductivity. Second, a novel method to modify the electronic structure and increase ZT was demonstrated recently by Heremans, Snyder and co-workers. The modification depends on creating a sharp density of states near the Fermi energy using non-magnetic valence-skipping dopants such as Tl. After presenting a brief history of thermoelectric materials research and a discussion of the basic physics of thermoelectric devices, the new developments will be briefly discussed. Research was sponsored by the Division of Material Sciences and Engineering, Office of Basic Energy Sciences, U.S. Department of Energy.