Abstract:

Prof. Tritt’s research emphasizes investigations of the thermal and electrical transport properties of new and novel solid-state materials, with the specific goal of achieving higher efficiency solid-state thermoelectric materials. Given our recent energy needs experienced in this country and high gasoline and fuel costs, alternative energy conversion technologies are becoming ever more important. Thermal to electrical energy conversion (that TE technologies can provide) is certainly one of those that is attracting additional interest. In particular, conversion of waste heat to power is of special importance to the automobile and trucking/transport industry since the electrical demands in modern vehicles are so high that they are outpacing the ability of on board generators to supply electricity. The incorporation of TE power generation through the recovery of the large amount of waste heat from an automobile’s exhaust or engine and harvesting this into usable “on-board” electrical energy can provide a reduced demand for fossil fuels and lessen their detrimental impact on the environment. In addition, the direct conversion of the IR spectrum of the sun can allow thermoelectric devices to perform this conversion process, which comprises over 40% of the solar energy spectrum.

He is currently focused on two promising research areas: nanocomposites and bulk materials with large complex unit cells. We utilize the expertise we have gained in the synthesis of thermoelectric nanostructure along with novel techniques of consolidation to form TE nanocomposites (a matrix of TE micron sized particles and nanomaterials). The materials will be compacted into highly densified pellets using our recently acquired spark plasma sintering equipment which can both form high density pellets (> 99% theoretical density) but also preserve the nanostructures due to the rapid compaction process thus minimizing diffusion. We have also explored the area of “grain boundary engineering” wherein the nanomaterials are synthesized directly onto the surfaces of the larger grains and then densified using hot pressing or SPS techniques. This allows the interface of the grains to be fully controlled and understood.

Prof. Tritt’s labs encompass over 3000 sq. ft of state of the art characterization and synthesis equipment making it one of the premier labs in the world for the investigation of thermoelectric materials as well as extensive investigations of thermal transport in complex solid-state systems. He has collaborations from all over the world in working with these exotic materials.