



Weekly Seminar

Decouple electron and phonon transport for high-performance thermoelectrics

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Time: 3:00 pm, Nov. 27, 2024 (Wednesday)

时间: 2024年11月27日 (周三) 下午3:00

Venue: Room w563, Physics building, Peking University

地点: 北京大学物理楼, 西563会议室

Abstract

Thermoelectrics enable direct heat-to-electricity transformation, but their performance has so far been restricted by the closely coupled electron and phonon transport. The figure of merit, ZT , is the essential measure of thermoelectric performance and can be calculated by $ZT = S^2\sigma T/\kappa$, where S , σ , κ , and T are Seebeck coefficient, electrical conductivity, total thermal conductivity and absolute temperature, respectively. Although established strategies to optimize ZT usually treat electrical and thermal properties separately, enhancing ZT requires simultaneous optimization of the adversely interdependent S , σ , and κ , which is challenging because most crystal imperfections are believed to scatter both phonons and electrons. This presentation will show that the power factor ($S^2\sigma$) can be boosted by trap hole release and energy-band engineering including band convergence. The total thermal conductivity can be suppressed by the introduction of all scale defects, high entropy, quantum gap and so on, which provide general methods for boosting their thermoelectric performance. It will also illustrate three examples (PbQ, GeTe, and AgCrSe₂) of emerging excitations in nanostructured materials and systems for thermoelectric materials. It will highlight the role of advanced and classical electron microscopy in unravelling the hierarchical architecture of the constituents and their intimate interplay in governing key phenomena in thermoelectric materials.

About the speaker

Jiaqing He is currently a chair professor at Southern University of Science and Technology (SUSTech). He received his joint Ph.D. degree in physics from both Juelich Research Center and Wuhan University in 2004. He was a postdoc at Brookhaven National Laboratory (2004-2008), research associate (2008-2010) and research assistant professor (2010-2012) at Northwestern University, and a professor at Xi'an Jiaotong University (2012-2013) and SUSTech (2013-2019). His research interests include transmission electron microscopy, thermoelectric materials, and structure and property relationship.