NTML(BRL)-APCTP SEMINAR SERIES

The unique properties of nanostructured topological matter

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Online via ZOOM

In this lecture, we debate about the interconnection between thermoelectric performance and topological insulator nature of chalcogenide-type materials [1,2]. While topological surface states seem to play positive role in the thermoelectric transport in (nanograined) bulk material, it will be shown that they contribute to the transport in nanostructures due to their high surface-to-volume ratio. By tuning the charge carrier concentration, a crossover between a surface-state-dominant and a Fuchs-Sondheimer transport regime is observed in ALD grown Sb2Te3 layers[3]. Magnetic ordering on the surface of a topological insulator nanowire could enable room-temperature topological quantum and spintronic devices. In general, we will discuss about the challenges to synthesize topological insulators which exhibit an insulating transport behavior at least at low temperatures.
Furthermore, the magneto-thermoelectric transport of Weyl semimetal like HfTe5 and NbP will be presented[4]. We have measured the chiral magnetoresistance in the Weyl semimetal NbP and detected signatures of the mixed axial-gravitational anomaly in the transport experiments. This work has stimulated a scientific discussion about the application of theoretical models from High Energy Physics in the area of thermoelectric materials. Many of these so-called quantum materials have been analyzed for thermoelectric applications in previous decades. An outlook will be given about magnetic doping of topological insulators and Weyl semimetals.

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[2] B. Hamdou, J. Kimling, A. Dorn, E. Pippel, R. Rostek, P. Woias, K. Nielsch. Thermoelectric Characterization of Bismuth Telluride Nanowires, Synthesized Via Catalytic Growth and Post-Annealing, Adv. Mater. 25, 239 (2013).
[3] N.F. Hinsche, S. Zastrow, J. Gooth, L. Pudewill, R. Zierold, F. Rittweger, T. Rauch, J. Henk, K. Nielsch, I. Mertig. Impact of the Topological Surface State on the Thermoelectric Transport in Sb2Te3 Thin Films, ACS Nano 9, 4406 (2015).
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