c hemisch
p hysikalische
g esellschaft

Gegründet im Jahre 1869 von H. Hlasiwetz, J. Loschmidt, J. Petzval und J. Stefan

EINLADUNG

zum Vortrag von

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Solution-processed thermoelectric materials: engineering performance through surface chemistry

am Dienstag, 24. Januar 2023, um 17:30 Uhr

Ort: Lise-Meitner-Hörsaal, Fakultät für Physik, Universität Wien,
1090 Wien, Strudlhofgasse 4 / Boltzmanngasse 5, 1. Stock

Barrierefreier Zugang: Boltzmanngasse 5, Lift, 1. Stock rechts über den Gang zum Hintereingang des Hörsaals

Abstract

Conforming thermal energy to electricity and vice versa through solid-state thermoelectric devices is appealing for many applications. Not only because thermal waste energy is generated in many of our most common industrial and domestic processes but also because thermoelectric devices can be used for temperature sensing, refrigeration, etc. However, their extended use has been seriously hampered by the relatively high production cost and low efficiency of thermoelectric materials. The problem is that thermoelectric materials require high electrical conductivity (σ), high Seebeck coefficient (S), and low thermal conductivity (□), three strongly interrelated properties

Thermoelectric materials are often dense, polycrystalline inorganic semiconductors. Usually, the processing of such materials has two steps: preparing the semiconductor in powder form and consolidating the powder into a dense sample. The most common route to prepare powders among the thermoelectric community is through high-temperature reactions and ball milling. Alternatively, solution methods to produce powders with much less demanding conditions (e.g. lower reagent purity, lower temperatures, shorter reaction times) have been explored to reduce the production costs. These methods also provide opportunities to produce particles with better-controlled features, such as crystallite size, shape, composition, and crystal phase, which allow modifying the properties of the consolidated material. However, when dealing with powders produced in solution, one should pay special attention to potential undesired elements coming from the reactants. Those elements may not affect the crystal structure and bulk composition of the powder but can be present as surface adsorbates. The composition, chemical stability, and bonding nature of surface species can influence the sintering process, and reaction byproducts can determine the final properties of the consolidated material.

Herein, we will demonstrate the importance of surface species in the use of solution-processed particles as precursors for bulk thermoelectric materials. In particular, we will provide examples in which surface species are used to deliberate control of the type and density of major carriers, engineer the electronic band structure, define composite microstructure, and hence charge carrier mobility and phonon transport.

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