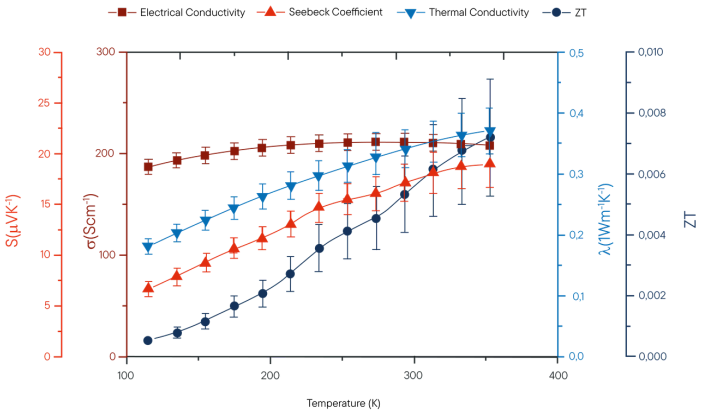
Thermoelectric Characterization of PEDOT:PSS Thin Films

TFA L59 Analysis of Temperature-Dependent Thermoelectric Properties

Conductive polymers such as PEDOT:PSS are promising materials for flexible and thin-film thermoelectric applications. Their performance depends on the interaction between electrical conductivity, Seebeck coefficient and thermal conductivity. In this study, the LINSEIS TFA L59 was used to characterize the temperature-dependent thermoelectric properties of a 15 µm PEDOT:PSS thin film. The combined measurements enable direct evaluation of the relevant transport properties and calculation of the thermoelectric figure of merit ZT.

Measurement Setup

- Instrument: LINSEIS TFA L59
- Material: PEDOT:PSS
- Sample: 15 µm PEDOT:PSS thin film
- Preparation: Drop casting
- Temperature Range: 110–420 K
- Measurements: Electrical Conductivity, Seebeck Coefficient & Thermal Conductivity



The measurements reveal the temperature-dependent thermoelectric behavior of the PEDOT:PSS thin film.

Key observations include:

- Electrical conductivity remains above approximately 180 S/cm across the investigated range
- Seebeck coefficient increases with temperature
- Thermal conductivity increases moderately with temperature
- The calculated ZT value continuously increases toward higher temperatures

The measured electrical conductivity, Seebeck coefficient and thermal conductivity are in good agreement with previously published data for untreated PEDOT:PSS.

Interpretation

The observed behavior can be attributed to:

- Temperature-dependent charge transport
- Stable electrical conductivity
- Increasing thermal conductivity

This results in:

- Increasing ZT with temperature
- Reliable thermoelectric characterization

Industrial Relevance

Thermoelectric thin-film characterization supports:

- Conductive polymer development
- Flexible thermoelectrics
- Thin-film electronics
- Energy harvesting
- Organic electronics
- Thermoelectric material optimization

Conclusion

The LINSEIS TFA L59 enables comprehensive characterization of the temperature-dependent thermoelectric properties of PEDOT:PSS thin films. By determining electrical conductivity, Seebeck coefficient and thermal conductivity on the same sample, the complete thermoelectric figure of merit ZT can be evaluated over a broad temperature range. The results demonstrate consistent temperature-dependent behavior and good agreement with previously published PEDOT:PSS data, highlighting the suitability of the measurement approach for the development and optimization of conductive polymers and thin-film thermoelectric materials.

Source:
Linseis, V., Völklein, F., Reith, H., Nielsch, K., Woias, P.
Advanced platform for the in-plane ZT measurement of thin films.
Review of Scientific Instruments, 89, 015110 (2018).
Adapted from thermoelectric measurements of a 15 µm PEDOT:PSS thin film performed using a LINSEIS Thin Film Analyzer (now designated as LINSEIS TFA L59).