LINSEIS

pushing boundaries

TFA L59

Thin Film
Analyzer

Since 1957 LINSEIS Corporation has been delivering outstanding service, know-how and leading innovative products in the field of thermal analysis and thermo-physical properties.

Customer satisfaction, innovation, flexibility, and high quality are what LINSEIS represents. Thanks to these fundamentals, our company enjoys an exceptional reputation among the leading scientific and industrial organizations. LINSEIS has been offering highly innovative benchmark products for many years.

The LINSEIS business unit of thermal analysis is involved in the complete range of thermoanalytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials, and environmental analytics. In addition, thermophysical properties of solids, liquids, and melts can be analyzed.

Rooted in a strong family tradition, LINSEIS is proudly steered into its third generation, maintaining its core values and commitment to excellence, which have been passed down through the family leadership. This generational continuity strengthens our dedication to innovation and quality, embodying the essence of a true family-run business.

LINSEIS provides technological leadership. We develop and manufacture thermoanalytic and thermophysical testing equipment to the highest standards and precision. Due to our innovative drive and precision, we are a leading manufacturer of thermal analysis equipment.

The development of thermoanalytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

CLAUS LINSEIS

CEO DIPL. PHYS.

To strive for the best due diligence and accountability is part of our DNA. Our history is affected by German engineering and strict quality control.

We want to deliver the latest and best technology for our customers. LINSEIS continues to innovate and enhance our existing thermal analyzers. Our goal is to constantly develop new technologies to enable continued discovery in Science.

Engineering & Innovation

Linseis
Service

Customized Solutions - The Linseis Advantage

At Linseis, we believe that every measurement challenge is unique — and so should be your instrument.
While many suppliers rely on standardized configurations, Linseis distinguishes itself through exceptional flexibility and the capability to deliver customer-specific adaptations in record time.

Our experienced engineering teams work hand in hand with you to design and implement fully customized solutions that meet your precise application requirements — whether that means a unique sensor configuration, an extended temperature range, or a specialized software integration.

With decades of experience and a modular product architecture, we turn customization into a standard service — fast, efficient, and reliable.
Choose Linseis and experience what true flexibility in thermal analysis and material characterization means.

Contact form

Service & Support

Redefining Ownership

When investing in analytical instrumentation, long-term value matters just as much as precision. That's why Linseis systems are engineered to deliver the lowest **Total Cost of Ownership** in their class — combining reliability, efficiency, and flexibility in every detail.

Our instruments are built with robust, high-quality components designed for longevity and minimal maintenance. This means fewer service interventions, shorter downtimes, and reduced operating costs over the entire product lifetime. Intelligent software updates and remote support further ensure that your system remains state-of-the-art, even years after installation.

Thin Film **Analyzer**

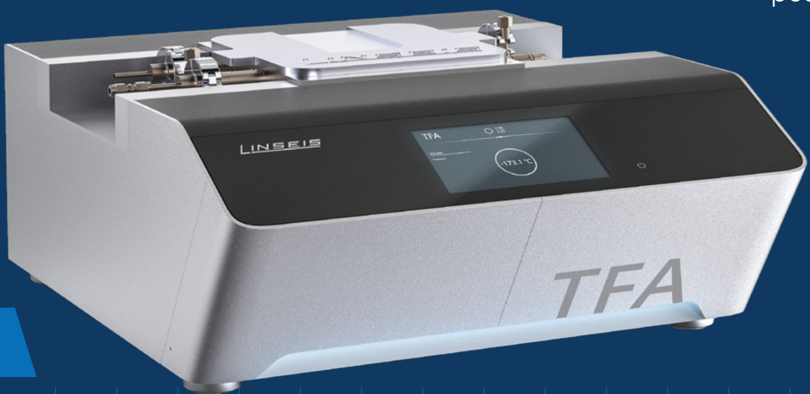
The LINSEIS Thin Film Analyzer TFA L59 is the perfect solution to characterize a broad range of thin film samples in a very comfortable and quick way. It is an easy to use, single stand alone system and delivers high quality results using an optimized measurement design as well as the proven LINSEIS Firmware and Software package.

Motivation

Due to new research efforts in the field of semiconducting materials with a focus on size effects, there is a growing need for measurement setups dedicated to samples with small geometrical dimensions like thin films and nanowires with considerably different physical properties than bulk material. The characterization of these samples is important to learn more about their structure and conduction mechanism but also important for technical applications.

Measurement Setup

The LINSEIS TFA is a chip-based platform to simultaneously measure the in-plane electrical and thermal conductivity, the Seebeck coefficient as well as the Hall constant of a thin film sample in the temperature range from -160°C up to 280°C and in a magnetic field of up to 1 T. Due to the design of the setup, time consuming preparation steps can be omitted and a nearly simultaneous measurement of the sample properties is achieved. Typical errors caused by different sample compositions, varying sample geometries and different heat profiles are avoided with this measurement method.
The System can handle a broad range of different materials. It is possible to measure samples with semiconducting behaviour as well as metalls, ceramics or organics. Therefore many different deposition methods like PVD or Spin coating and drop casting are possible to use.

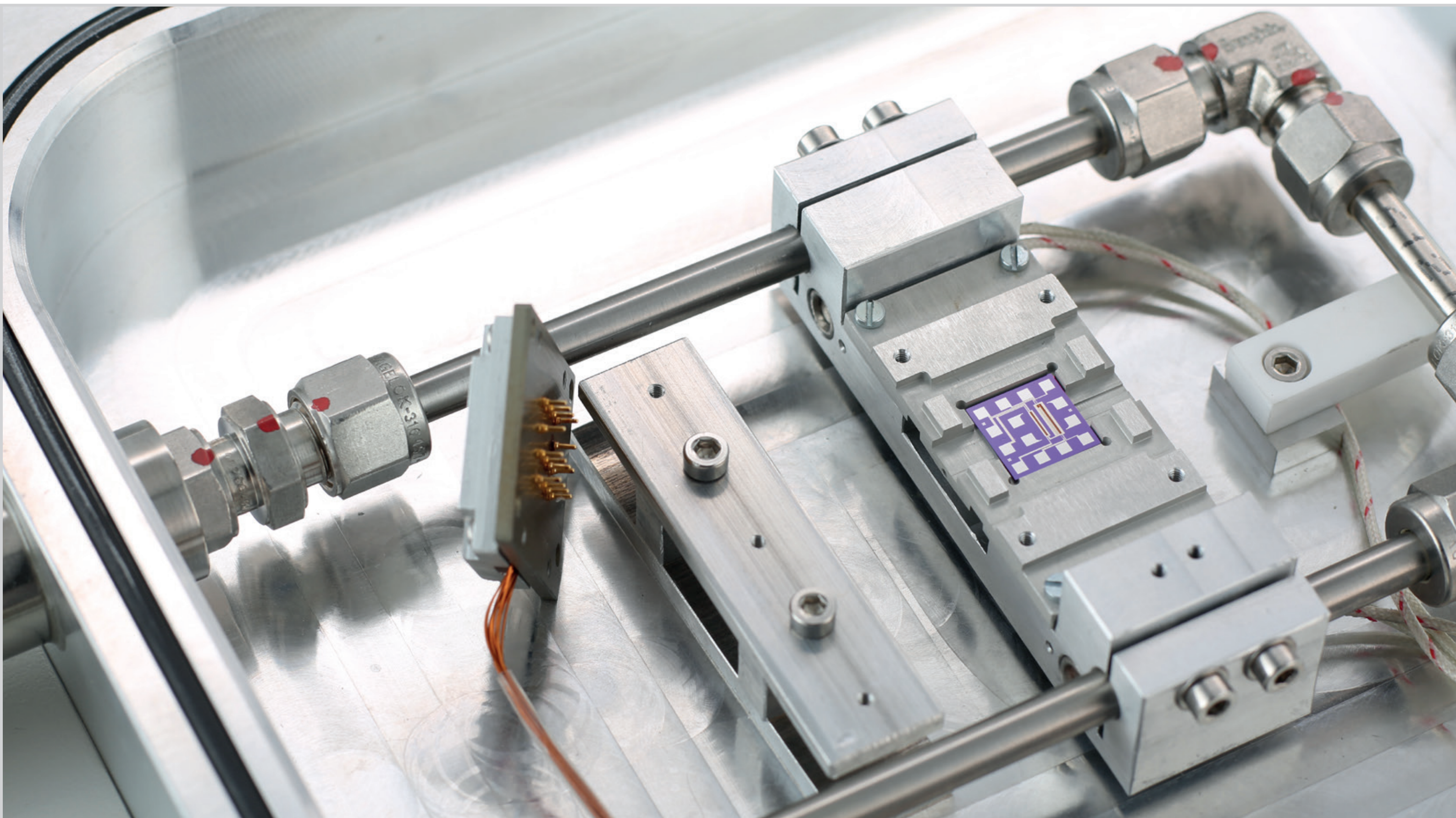


Components

The basic setup consists of a measurement chip on which the sample can be easily deposited, and the measurement chamber to provide the required environmental conditions. Depending on the application, the setup can be utilized with a Lock-In amplifier and / or a strong electric magnet. The measurements are usually taken under UHV and the samples temperature can be controlled between -160°C and 280°C during the measurement using LN_2 and powerful heaters.

Modular Design

Starting with a basic setup to measure the thermal conductivity, the system can easily be upgraded with either the thermoelectric kit to measure the electrical conductivity and Seebeck coefficient or with the magnetic upgrade kit to take Hall constant, mobility and charge carrier concentration measurements.



Packaging options

Following packaging options are available for the LINSEIS Thin Film Analyzer (TFA L59):

1. Basic device (incl. transient package)

Consists of measurement chamber, vacuum pump, basic sample holder with included heater, system integrated lock-in amplifier for the 3w-method, PC and LINSEIS Software package including measurement and evaluation software. The design is optimized to measure following physical properties:

- λ - Thermal Conductivity
- c_p - Specific Heat
- ε - Emissivity (depends on material)

2. Thermoelectric package

Consisting of extended measurment electronics (DC) and evaluation software for thermoelectric experiments. The design is optimized for measuring the following parameters:

- σ - Electrical Conductivity / Electrical Resistivity
- S - Seebeck Coefficient

3. Magnetic package

The design is optimized for measuring the following parameters:

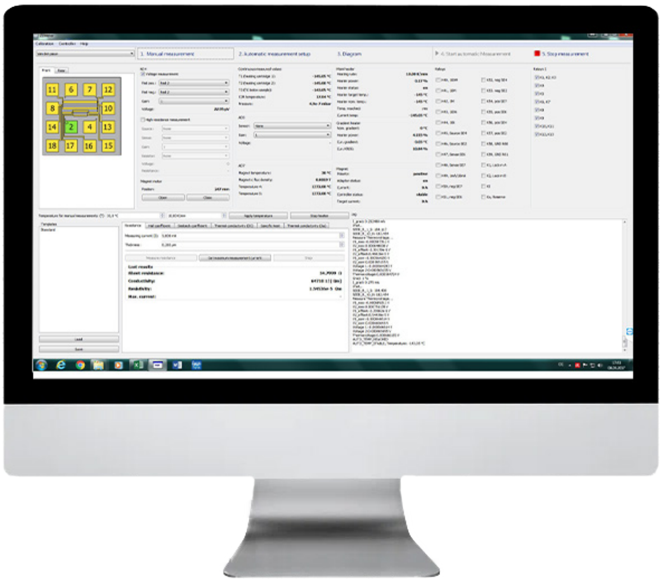
- A_H - Hall Constant
- μ - Mobility
- n - Charge carrier concentration

4. Low temperature option for controlled cooling down to -160°C

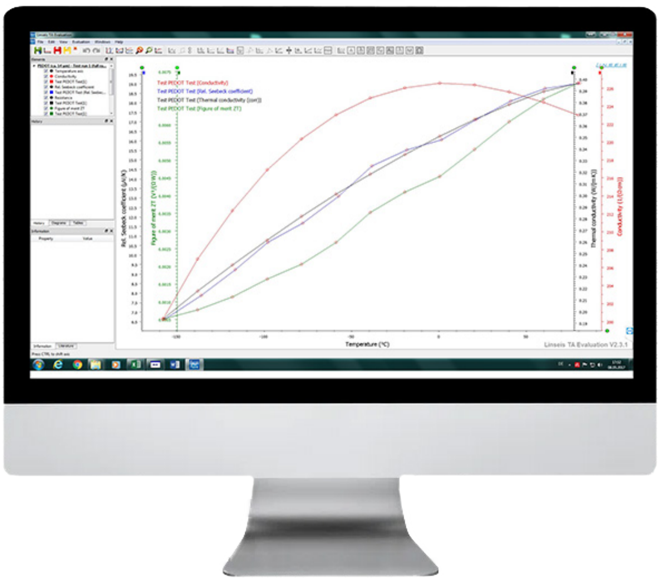
- TFA/KREG controlled cooling unit
- TFA/KRYO Dewar 25l

Software

The TFA software package consists of two parts. A measurement software which displays the actual values as well as allows to define a measurement routine and the dircet control of the setup. And an additional evaluation software for the post processing of the measured raw data.



Measurement Software



Evaluation Software

Measuring Principles

The chip is combining the 3 Omega measurement technique for the thermal conductivity measurement with a 4-point Van-der-Pauw setup for the determination of the electrical transport properties. The Seebeck coefficient can be measured using additional resistance thermometers located near the Van-der-Pauw electrodes. For an easy sample preparation either a strip off foil mask or a metal shadow mask can be used. This configuration allows for a nearly simultaneous characterization of a sample which has been prepared by either PVD (e.g. thermal evaporation, sputtering, MBE), CVD (e.g. ALD), spin coating, drop casting or ink-jet printing in one step.

Van-der-Pauw measurement

To determine the electrical conductivity (s) and Hall coefficient (AH) of the sample, the Van-der-Pauw method is used. After depositing the sample on the chip, it is already connected to four electrodes A, B, C & D at their edge. For the measurement, a current is applied between two of the contacts and the corresponding voltage between the remaining two is measured. By clockwise changing of the contacts and repeating of the procedure, the resistivity of the sample can be calculated using the Van-der-Pauw equation.

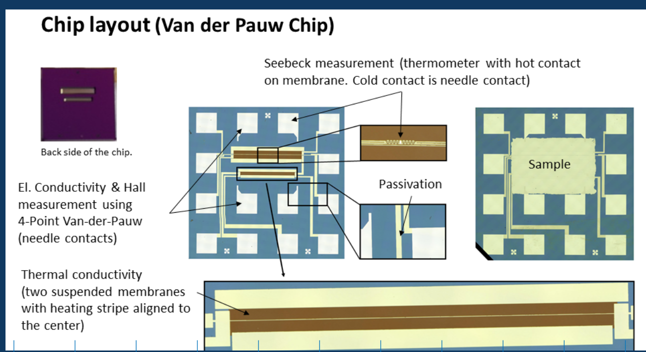
$$\exp\left(-\frac{\pi d}{\rho} R_{AB,CD}\right) + \exp\left(-\frac{\pi d}{\rho} R_{BC,DA}\right)$$

By applying a magnetic field and measuring the corresponding change of the diagonal Van-der-Pauw resistance, the Hall coefficient of the sample can be calculated.

$$A_H = \frac{d}{B} \cdot \Delta R_{AC,BD}$$

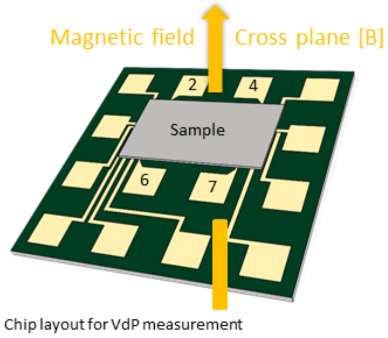
For the determination of the Seebeck Coefficient, an additional thermometer and heater is placed on the chip near the sample. This configuration allows for the measurment of the thermovoltage at different temperature gradients wich can be used in order to calculate the Seebeck Coefficient S=-Vth/ΔT.

$$S = -V_{th} / \Delta T$$



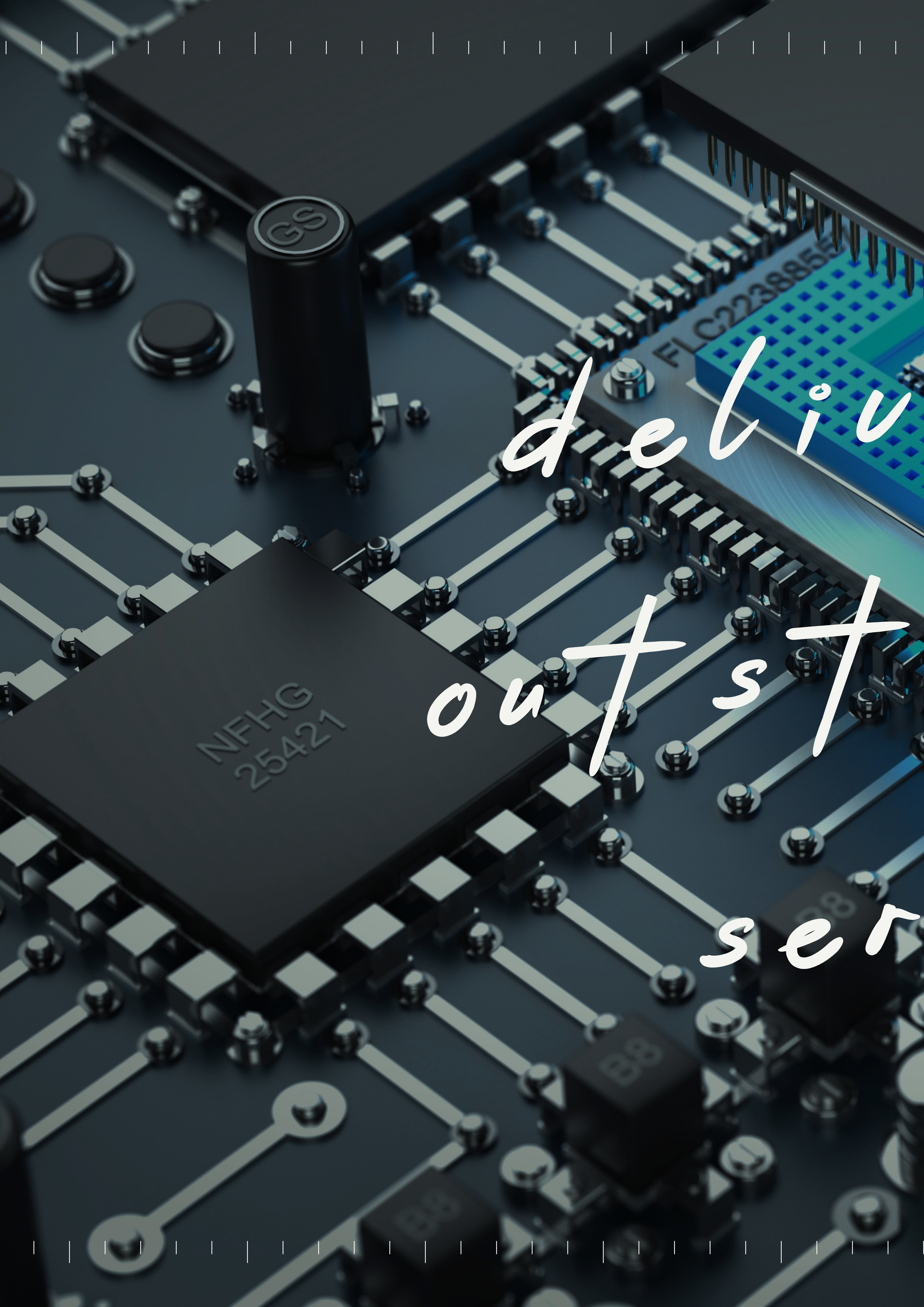
Options

TFA with moveable electromagnet (up to 1 Tesla)



VdP Hall coeffitient measurement

TFA with permanent magnet (up to 0.5 Tesla)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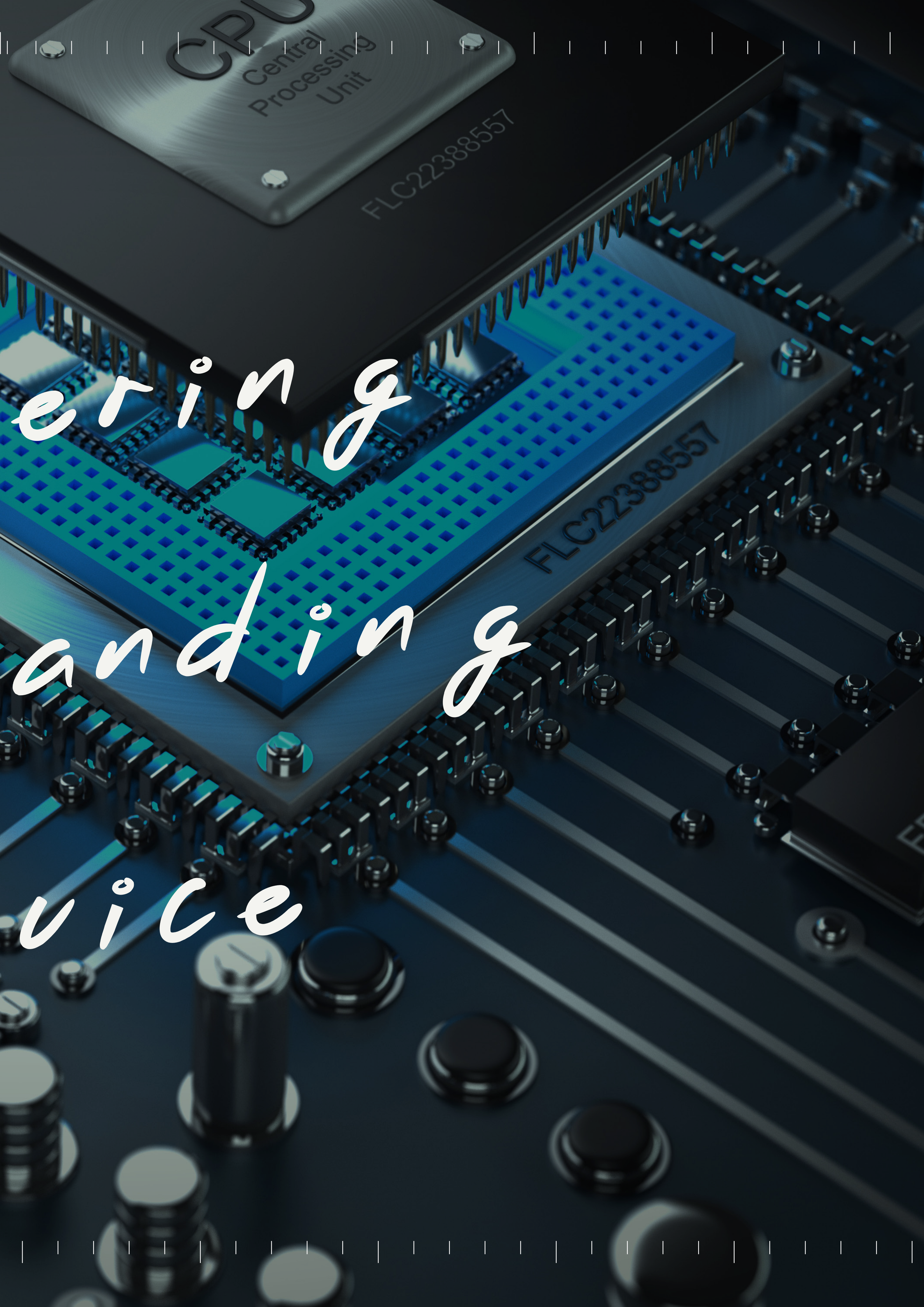
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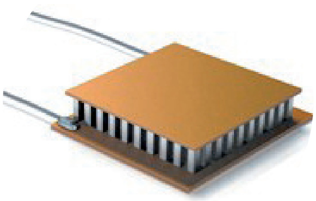
Technical
Specifications

	TFA L59
Temperature range	-160 °C up to 280 °C
Sample thickness	from 5 nm to 25 µm*
Measurement principle	chip based (pre structured measurement chips, 24 pcs. per box)
Desposition techniques	include: PVD (sputtering, evaporation) ALD, spin coating, ink-jet printing etc.
Measured parameters	Thermal Conductivity (3 Omega) Specific Heat
Optional	Seebeck Coefficient Electrical Resistivity/ Conductivity Hall Contant/ Mobility/ Charge carrier conc. permanent magnet 0.5 T or electromagnet up to 1 T
Vacuum	up to 10^{-5}bar
Electronics	integrated
Interface	USB
Measurement range	
Thermal Conductivity	0.05 up to 200 W/m·K
Electrical Resistivity	0.05 up to $1 \cdot 10^6$S/cm
Seebeck Coefficient	5 up to 2500 µV/K
Hall Mobility	1 up to 10^7 (cm^2 /Volt sec)
Charge Carrier Concentration	10^7 up to 10^{21} ($1/cm^3$)

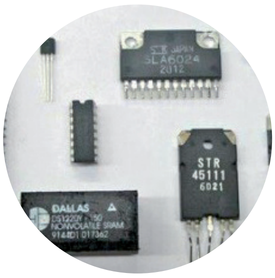
* range depends on sample

	TFA L59
Reapeatability & Accuracy	
Thermal Conductivity	± 7% (for most materials)
Electrical Resistivity	± 3% (for most materials)
Seebeck Coefficient	± 5% (for most materials)
Hall Mobility	± 9 % for most materials

Applications



Thermoelectric devices



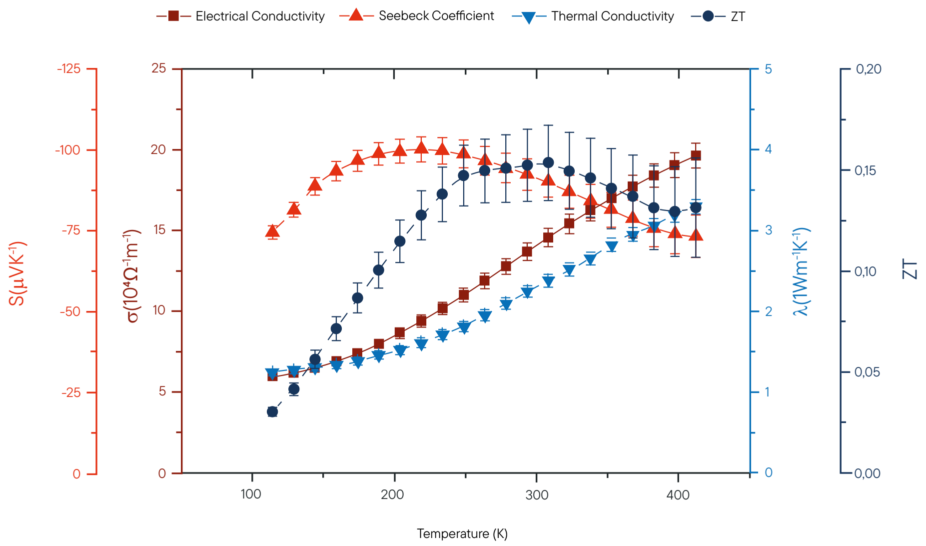
Integrated devices

Thermal barrier coatings

Tribological stress

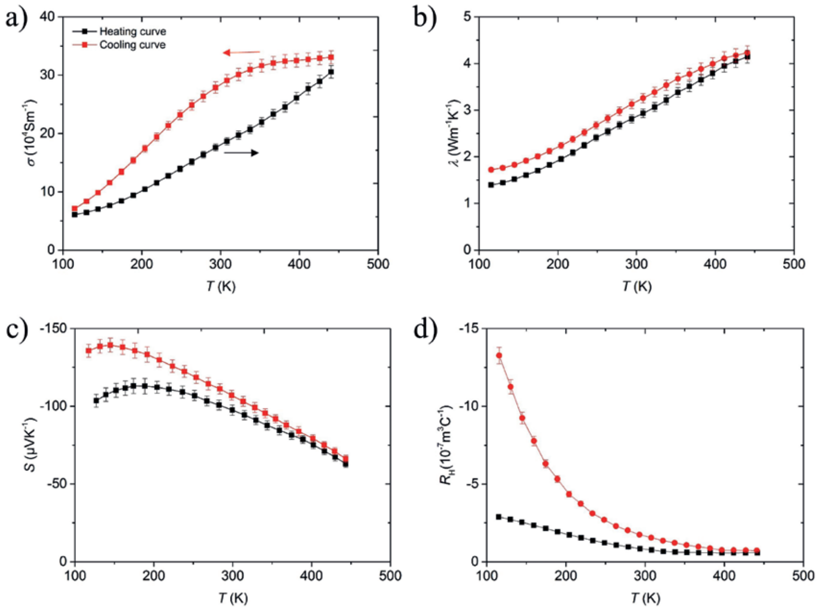
Applications

Full ZT Characterization of a 142 nm $Bi_{87}Sb_{13}$ thin film



Measured electrical conductivity, thermal conductivity and Seebeck coefficient as well as calculated ZT value of a 142 nm thick $Bi_{87}Sb_{13}$ nanofilm, prepared by thermal evaporation in the temperature range from -160°C up to 140°C.

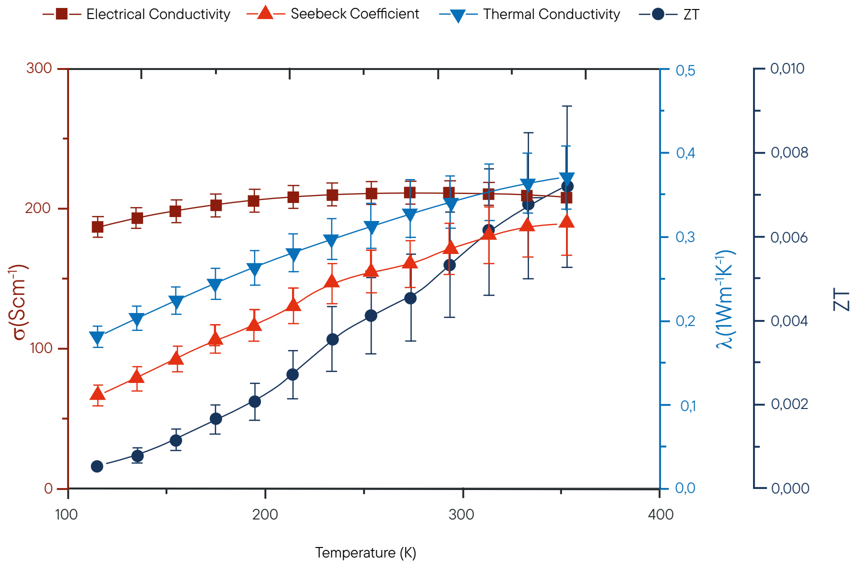
Thermal annealing effects observed at a $Bi_{87}Sb_{13}$ thin film



Thermal annealing effects observed at a 282 nm thin $Bi_{87}Sb_{13}$ nanofilm prepared by thermal evaporation. After the first measurement run at elevated temperatures, the thermoelectric properties show strong thermal annealing effects caused by recristallisation and defect healing processes.

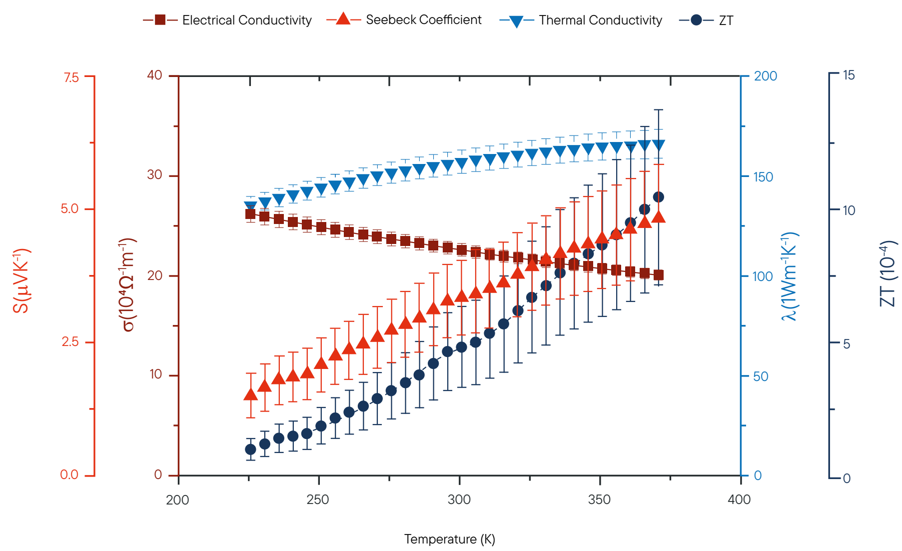
More applications

Full ZT Characterization of a PEDOT:PSS layer



Measured electrical conductivity, thermal conductivity and Seebeck coefficient as well as calculated ZT value of a 15 µm thick PEDOT:PSS thin film, prepared by drop casting in the temperature range from -150°C up to 100°C.

Full ZT Characterization of a Gold nanofilm



Measured electrical conductivity, thermal conductivity and Seebeck coefficient as well as calculated ZT value of a 100 nm Au thin film, prepared by DC magnetron sputtering in the temperature range from -50°C up to 100°C. The results preflectly agree with the Wiedemann -Franz law and a clear influence of classical size effects has been observed.