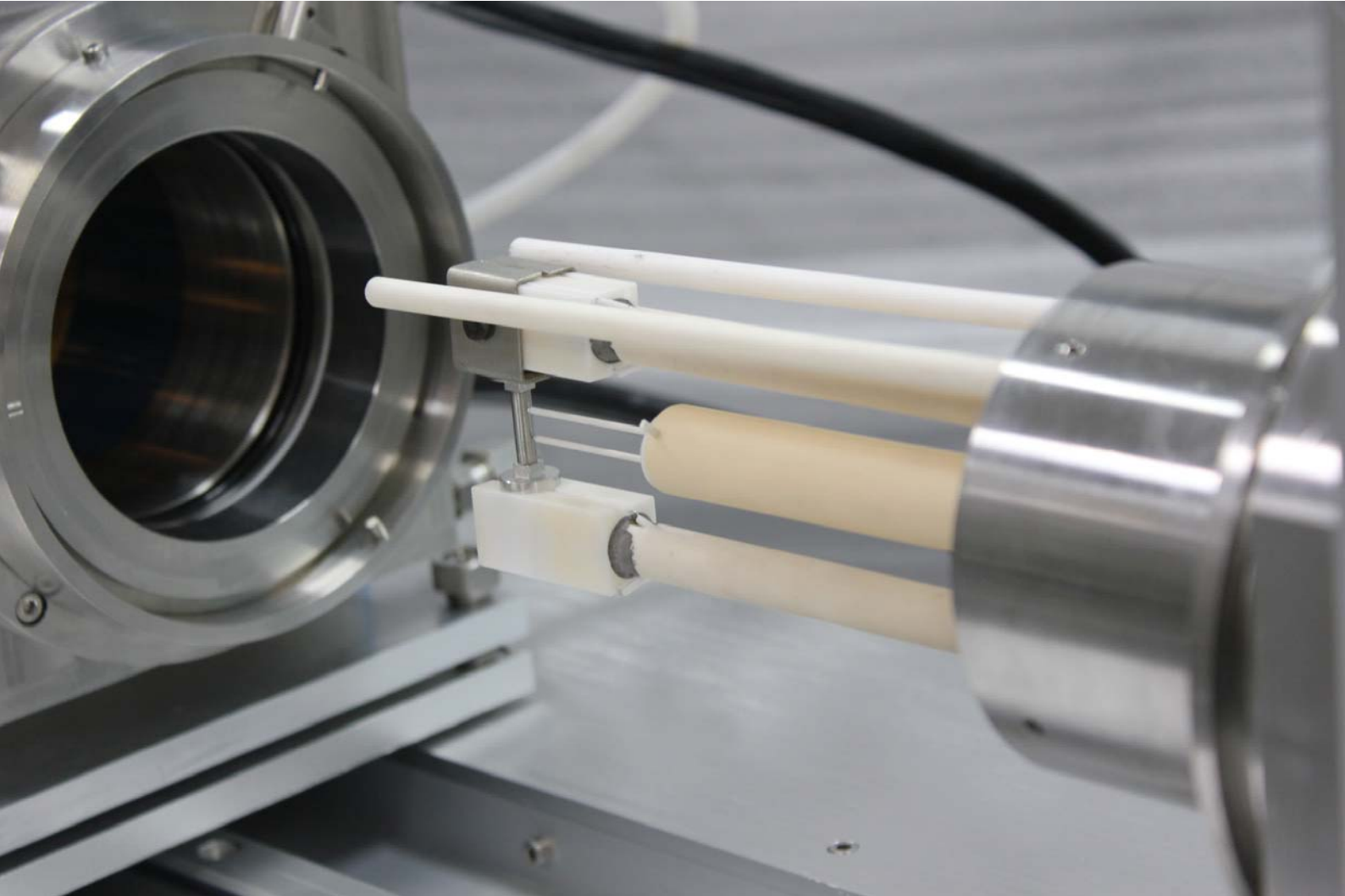


Seebeck Coefficient Electric Resistance Measurement System



SeebeckPro by Setaram

The burning of fossil fuels results in the production of carbon dioxide, which is the primary greenhouse gas and caused global warming. Thermoelectric devices, which convert the wasted heat to electricity, provide an efficient way for energy recycling. And the related researches are rapidly growing in the recent years. SETARAM SeebeckPro brought to you the best instrument solution for your research. SeebeckPro can measure both Seebeck coefficient and electric resistance simultaneously, and it works in the temperature range from -100°C to 1150°C.

The thermoelectric effectiveness is often described by its figure of merit, ZT, which is given by:

$$ZT = S^2 \cdot \sigma \cdot T / k$$

S: Seebeck Coefficient

σ : Electrical Conductivity

T: Absolute temperature

k: Thermal conductivity

SeebeckPro results the Seebeck Coefficient directly in the measurement, while it measuring the electric resistivity ρ , and converting it into electrical conductivity σ by the formula $\sigma = 1/\rho$.



Principles of Measurement

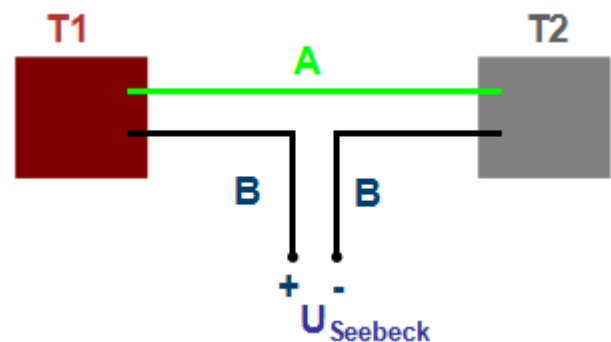
The electric potential difference, U_{Seebeck} , which is generated by the thermoelectric device in the figure can be presented by:

$$U_{\text{Seebeck}} = S \cdot (T_2 - T_1) = S \cdot \Delta T$$

A, B: A pair of different materials of metal connect
different temperature field

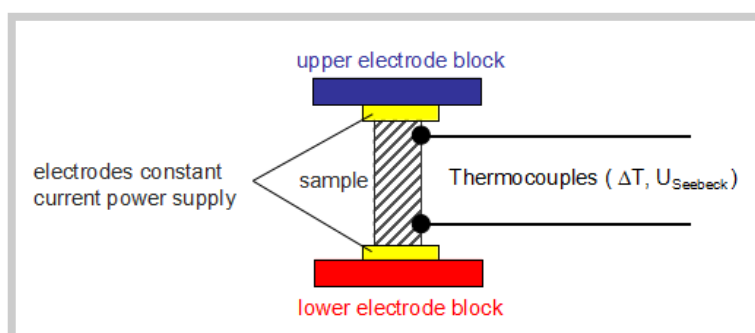
$T_2 - T_1$: The temperature difference of hot end and
cold end

S: Seebeck Coefficient



$$S = U_{\text{Seebeck}} / \Delta T$$

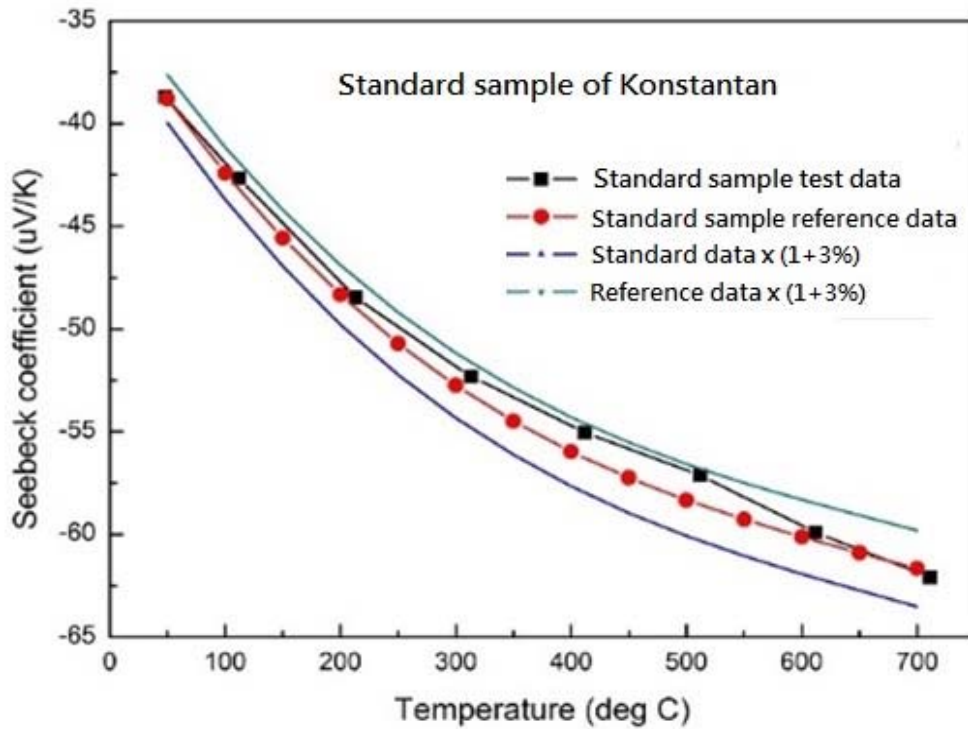
In the figure, a thermoelectric sample with cylindrical or prism shape is vertically placed between two electrodes, and the entire measurement is located inside a furnace, where the preset temperature of the furnace heats the sample. Besides a secondary heater is attached to the lower electrode block, and it generates a set temperature gradient. Then, the two contacting thermocouples measure the temperature gradient, T1 and T2., as well as the electric potential difference, U_{Seebeck}, by a unique mechanical design.



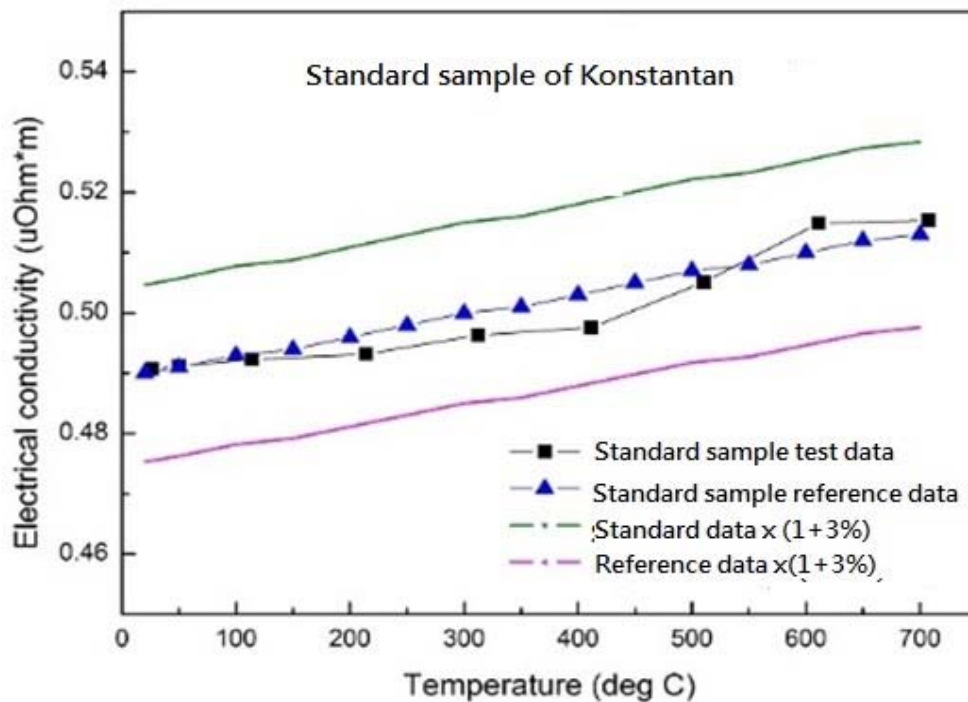
Specifications

Temperature range	-100°C up to 500°C ; RT up to 800°C / 1150°C
Rate of temperature control	0.01 – 100 K/min
Temperature accuracy	+/-0.5 K
Measurement method	Seebeck coefficient: Static DC method
	Electric resistance: four-terminal method
Measurement range	Seebeck coefficient : 0.5 μV/K-25V/K
	Electric resistance : 0.2 μOhmm-2.5KOhmm
Resolution	Seebeck coefficient : 10 nV/K
	Electric resistance : 10 nOhmm
Precision	Seebeck coefficient : ± 7 %
	Electric resistance : ± 10 %
Electric current	0 to 160 mA
Atmosphere	inert, oxid., red., vac.
Sample size	Diameter or square : 2 to 4 mm ; Length : 6 to 22mm
Sample size of wafer	Ø 10-12.7-25.4 mm

SeebeckPro: Comparison of Seebeck Coefficient test data and reference data within $\pm 3\%$



SeebeckPro: Comparison of electric conductivity test data and reference data within $\pm 3\%$



Features

- Simultaneous seebeck coefficient and electrical resistivity measurement
- Vertical or horizontal sample holder for user convenience
- Benefits from large cross-section Pt electrode, offers good contact with sample, especially for the electric conduction measurement for heterogeneous sample
- Dual heating system option, for the ΔT control of heterogeneous sample
- Advanced program for temperature control, including ΔT and stepwise measurement
- Customized setting for ΔT value and number of ΔT
- Heating and cooling, precise temperature programming, measurement in heating, isotherm and cooling
- S/C type thermal couple available for temperature testing, especially for Si series thermoelectric material(SiGe, MgSi etc.)
- Distance between thermocouples is customizable with sample size
- Security design for over protection, prevent explosion during tests
- Measurement system: column, sheet, cuboid, film
- Option for high resistance materials measurement up to 10M Ω



The First Choice for Challenging Thermal Analysis and Calorimetry Applications

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