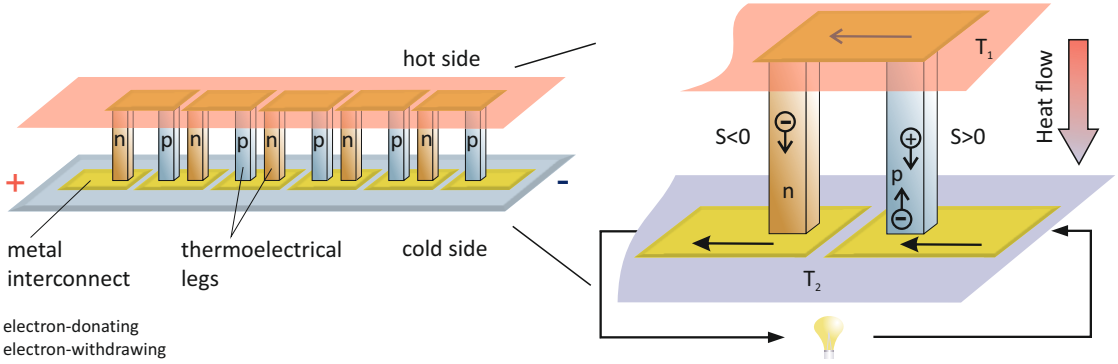
Leibniz-Institut
für Polymerforschung
Dresden

Thermoelectric materials and generators

Thermoelectricity is the interdependence of temperature and electricity. If different temperatures are applied to the ends of an electrically conductive material, a potential difference arises which is defined as a thermoelectric voltage. The German physicist THOMAS JOHANN SEEBECK first described this effect in 1823.

$$\textit{Seebeck coefficient } S = \frac{\textit{thermovoltage } U}{\textit{temperature difference } \Delta T}$$

Thermoelectrical Generator (TEG)

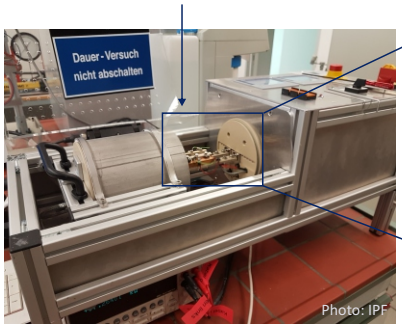


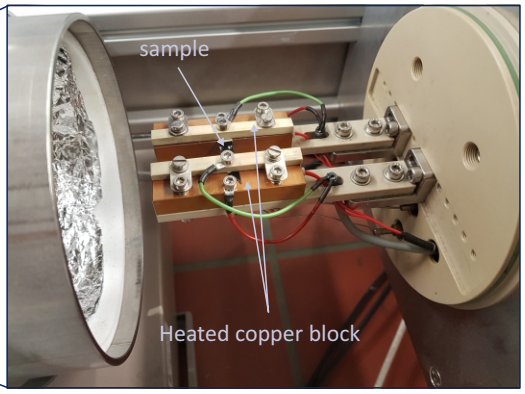
n: electron-donating
p: electron-withdrawing

The Seebeck effect: transformation of heat into electrical energy

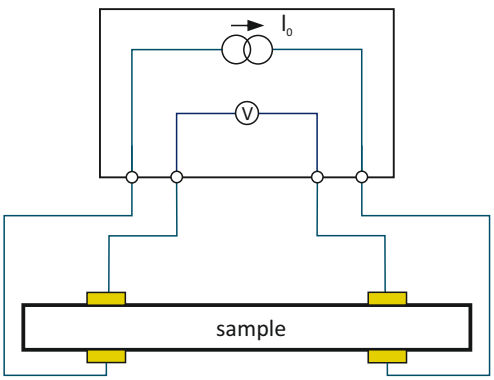
In-house development of a measuring device for simultaneous measurement of thermoelectric voltage and electrical resistance [1]

Temperature controlled housing
Working temperature up to 110°C

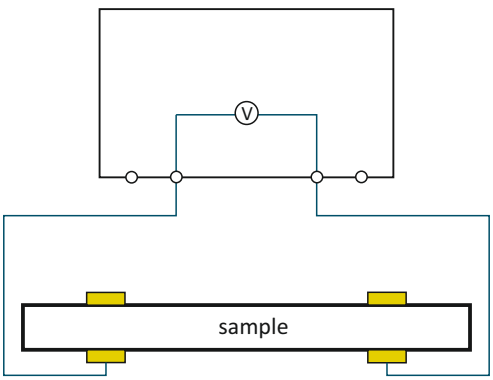




Wiring diagram

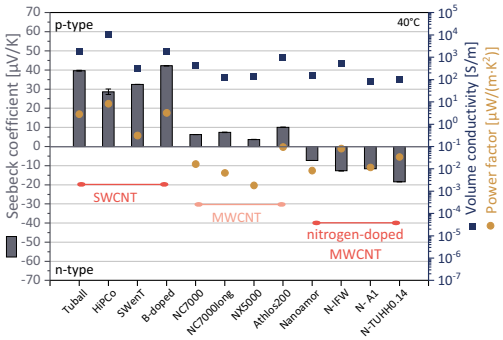


Measurement of electrical resistance

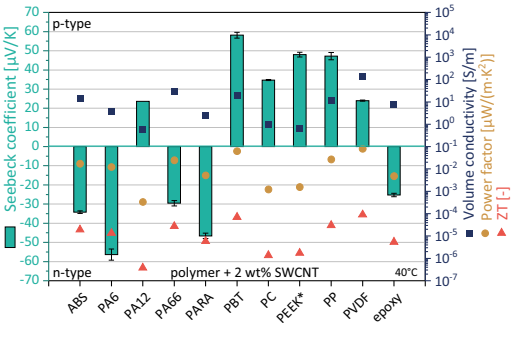


Measurement of thermoelectrical voltage

Carbon nanotube (CNT) powders:
TE performance is strongly dependent on the CNT type [2-5]

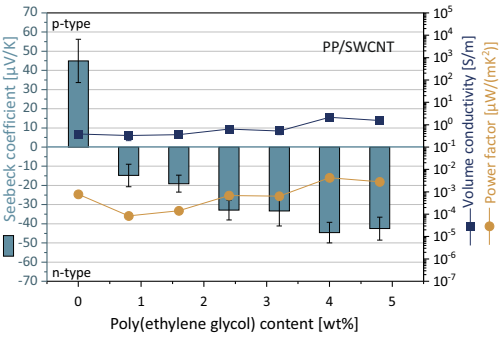


Polymer/SWCNT composites:
The polymer type influences whether p- or n-type behaviour occurs [2, 4, 5]

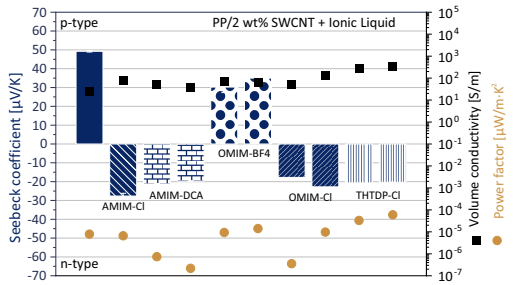


Additives to change from p-type to n-type behaviour in polymer/SWCNT composites:

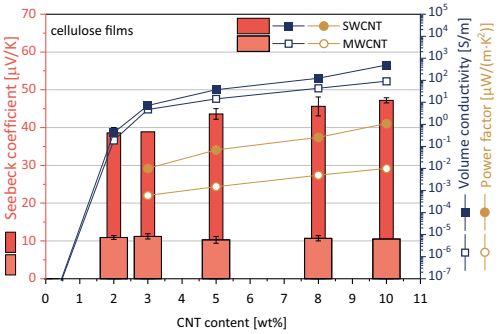
Polyethylene glycol [6]



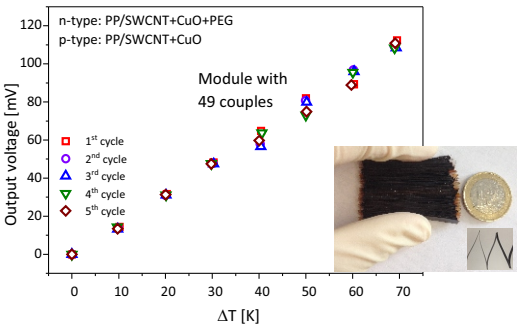
Ionic liquids [8]



Cellulose/CNT composites:
The CNT type influences the TE performance [7]



Thermoelectric module (zig-zag) made of p- and n-type materials [6]



References

[1] Technisches Messen 2020, 87, 495-503
[2] Nanomaterials 2020, 10, 1144
[3] Journal of Composites Science 2020, 4, 14
[4] Energies 2020, 13, 394
[5] Journal of Composites Science 2019, 3, 106
[6] Polymer 2017, 108, 513-520
[7] Composites Science and Technology 2018, 163, 133-140
[8] Journal of Composites Science 2022, 6, 25

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