

Overview of thermoelectric materials based on polymers and CNTs

P. Pötschke, J. Pionteck, B. Krause

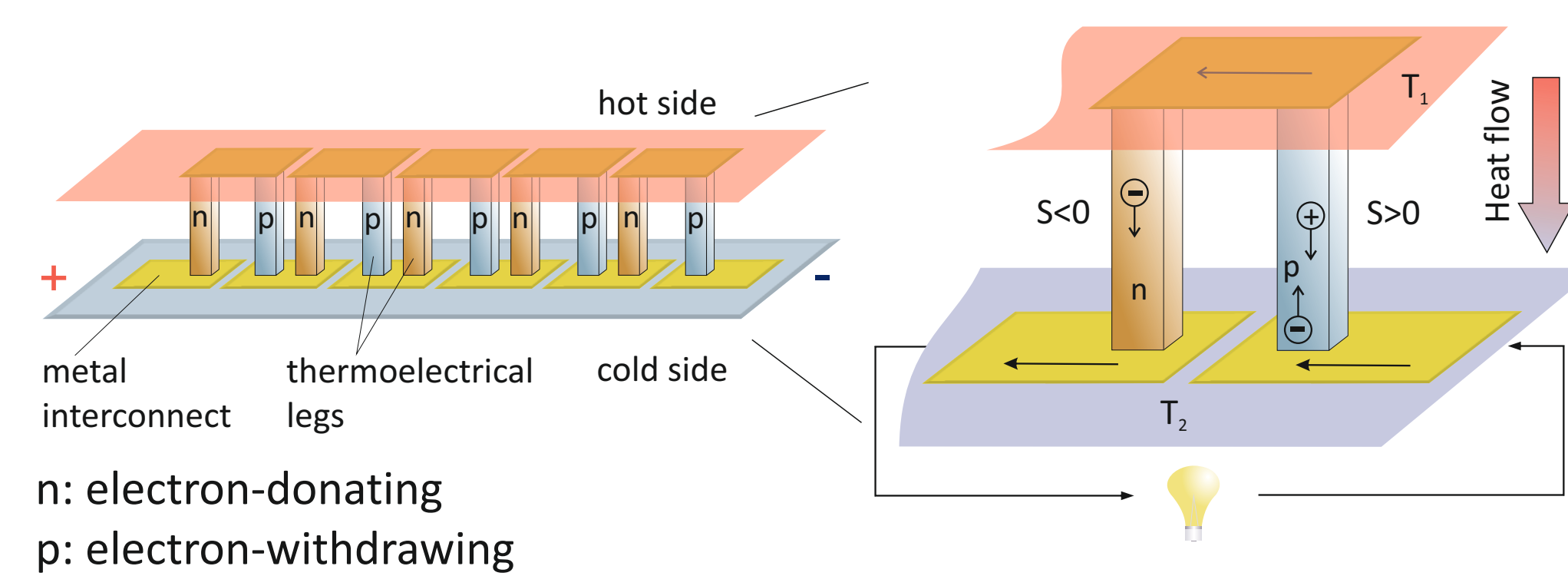
Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Str. 6, 01069 Dresden, Germany

Thermoelectricity (TE) 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.



Photo: S. Döring

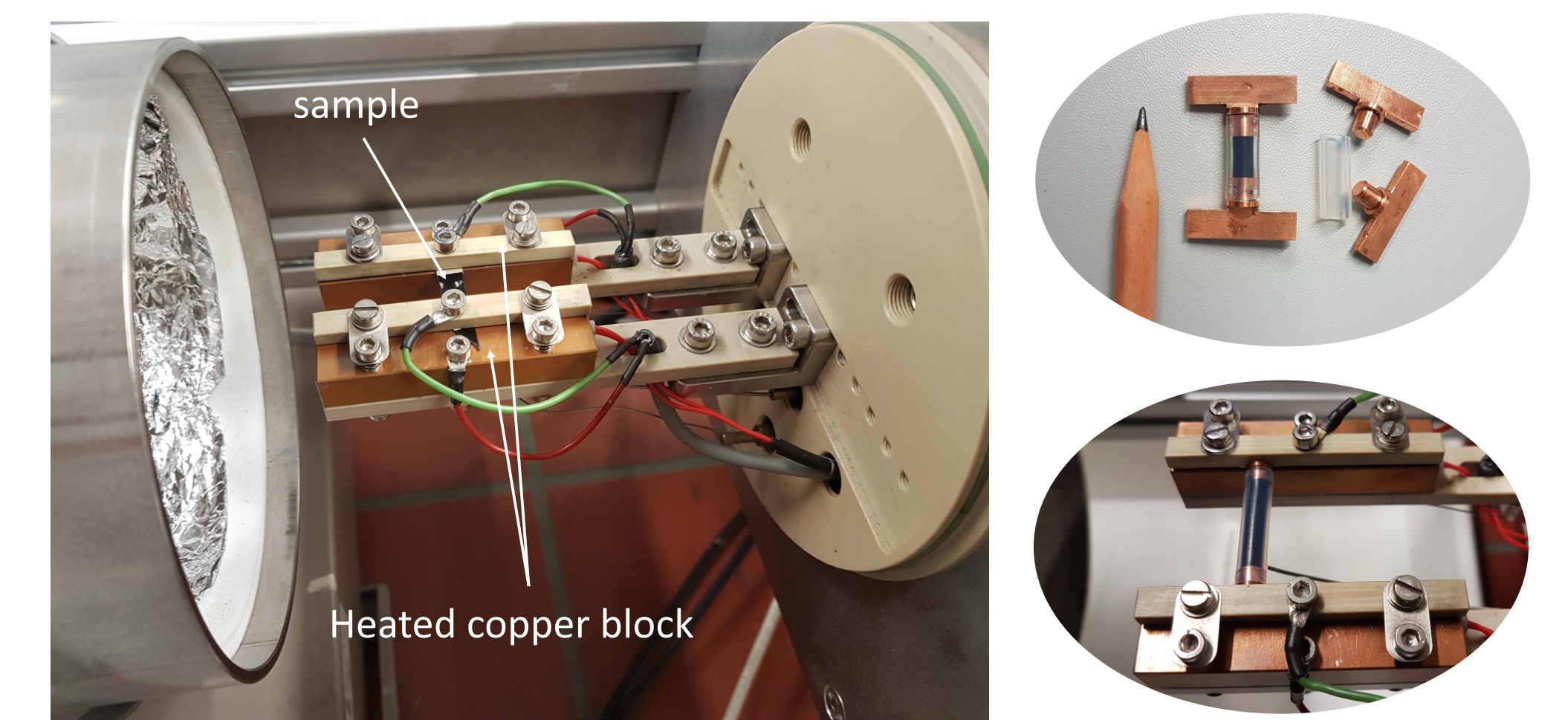
Thermoelectric module



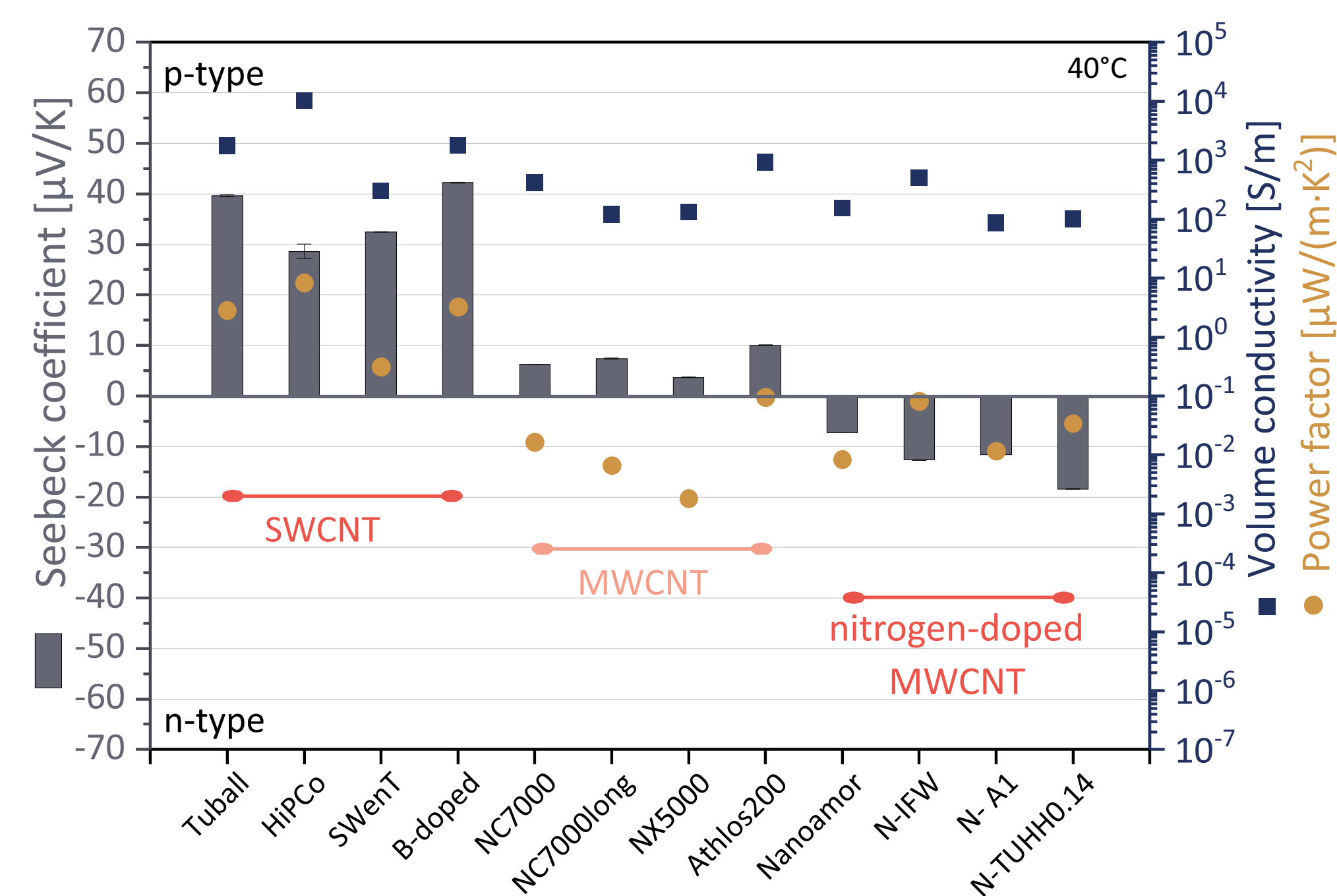
$$S = \frac{U}{\Delta T} \quad PF = S^2 \sigma \quad ZT = \frac{S^2 \sigma}{\kappa} T$$

S = Seebeck coefficient
PF = Power factor
U = Thermovoltage
 σ = Volume conductivity
T = Temperature
ZT = Figure of merit
 κ = Thermal conductivity

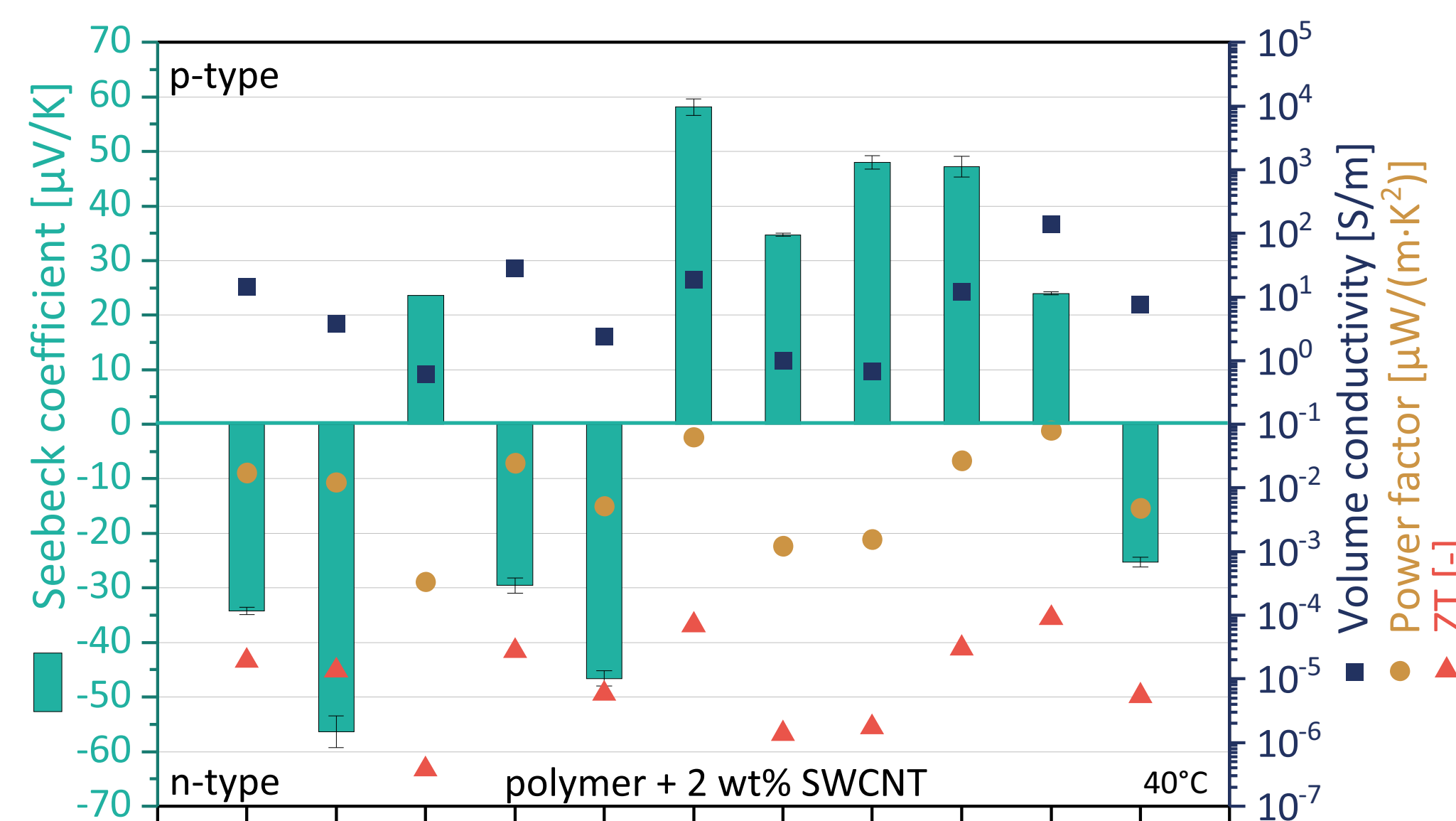
In-house development of a measuring stand for simultaneous measurement of thermoelectric voltage and electrical resistivity [1]



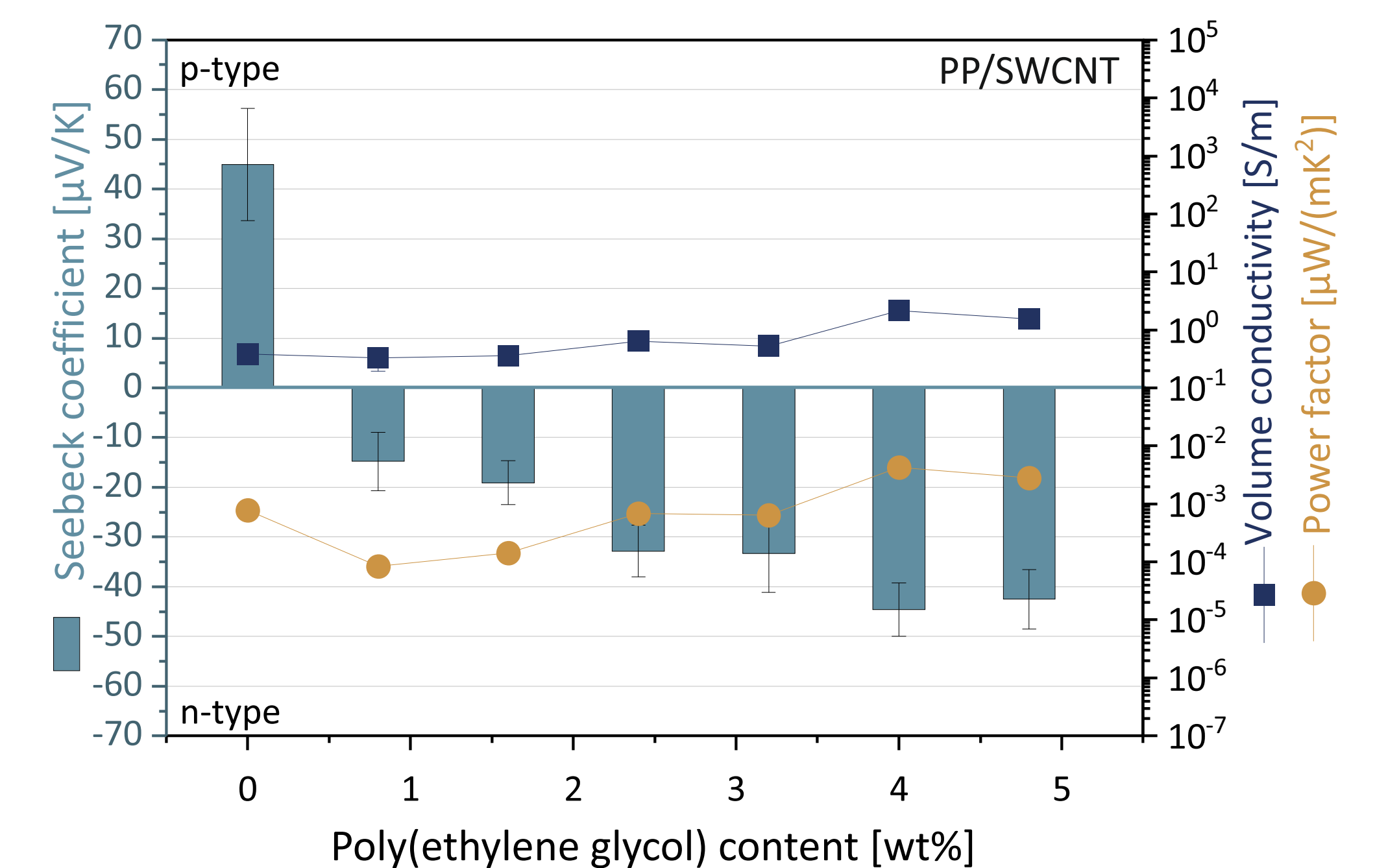
Carbon nanotube (CNT) powders: TE performance is strongly dependent on the CNT type [2-5]



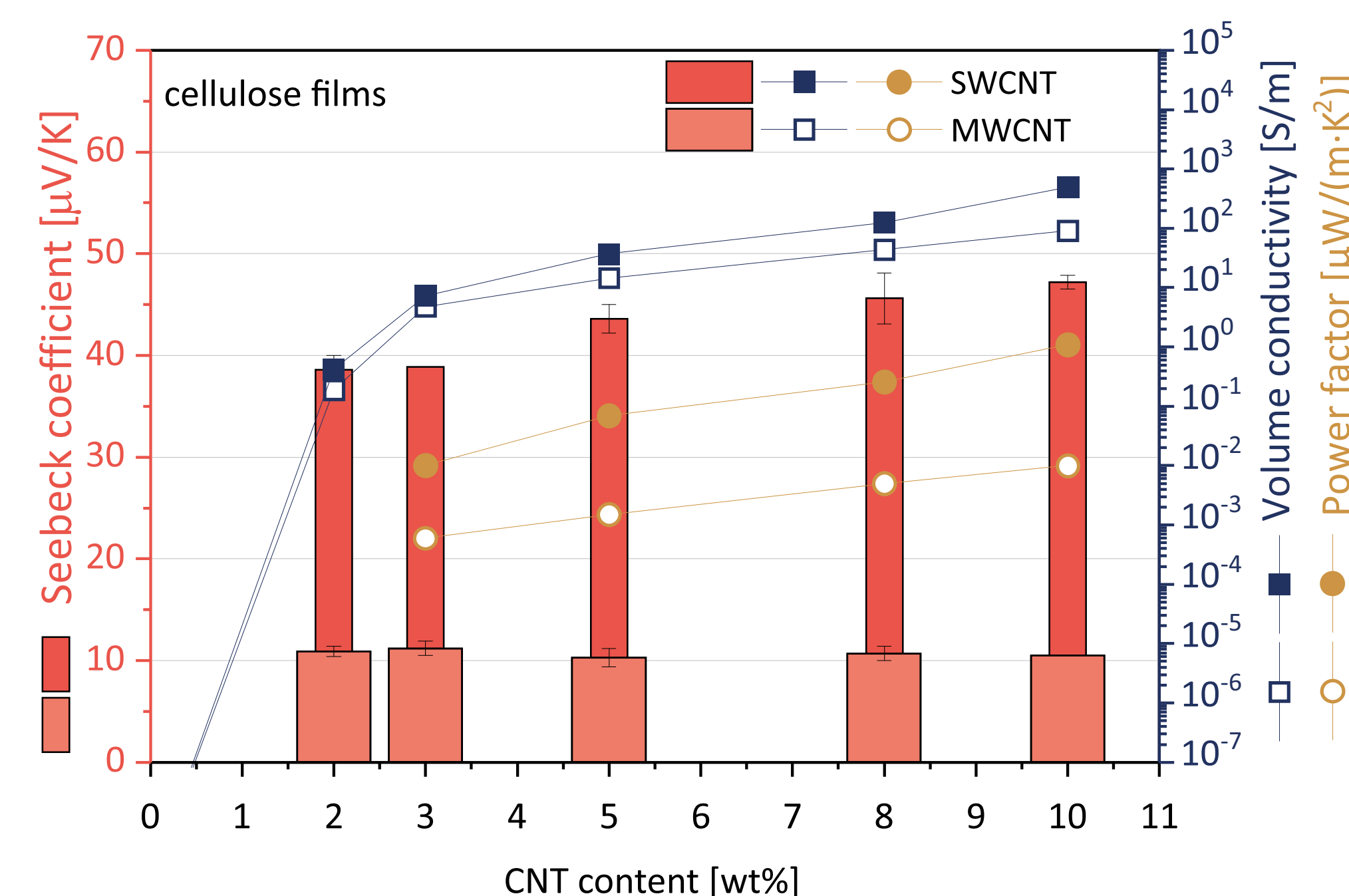
Polymer/SWCNT composites: The polymer type influences whether p- or n-type behaviour occurs [2, 4, 5]



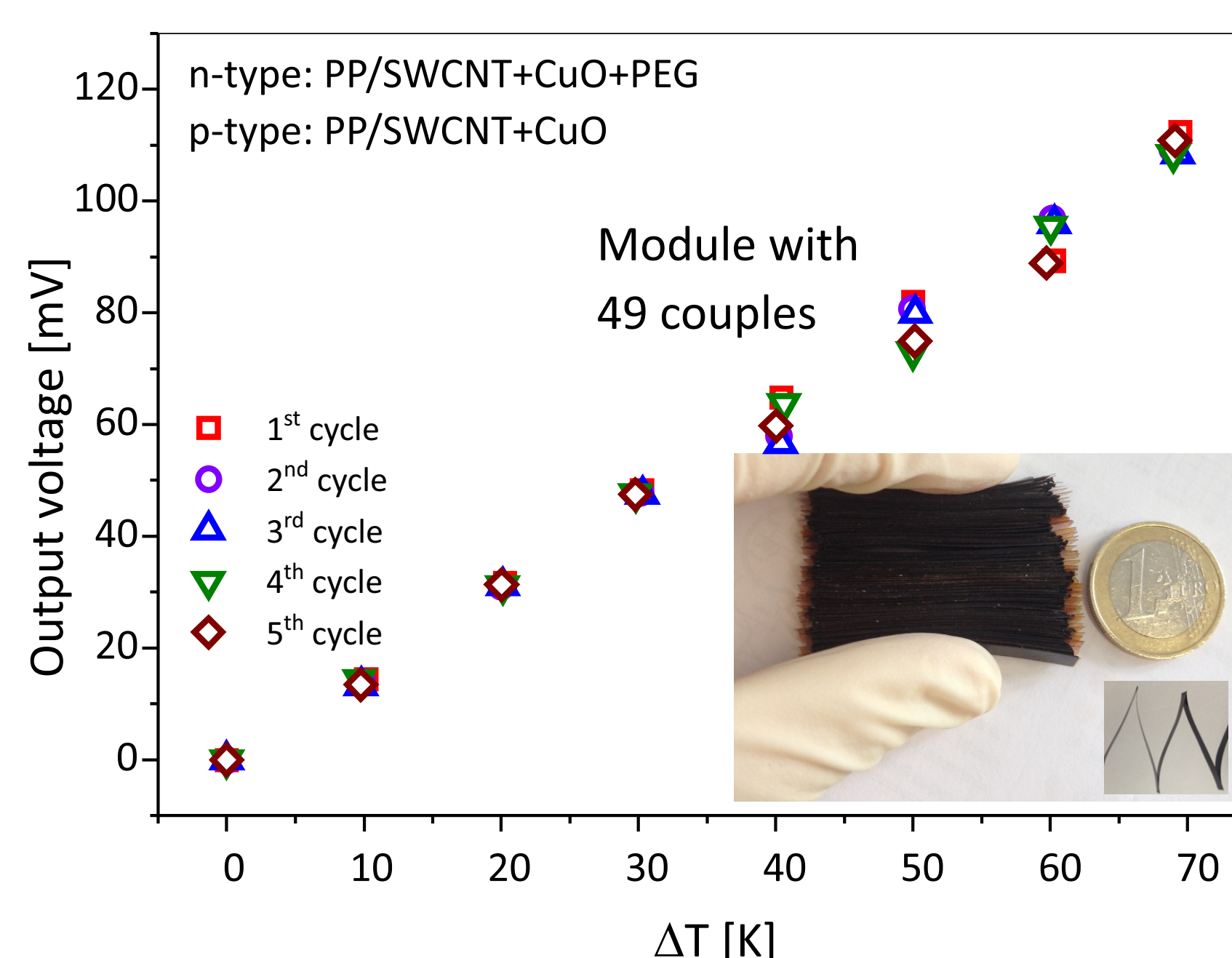
Polymer/SWCNT composites with additives: The additive influences whether p- or n-type behaviour occurs [6]



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] W. Jenschke, M. Ullrich, B. Krause, P. Pötschke, *Technisches Messen* 2020, 87, 495-503
- [2] K. Kröning, B. Krause, P. Pötschke et al., *Nanomaterials* 2020, 10, 1144
- [3] B. Krause, P. Pötschke et al., *Journal of Composites Science* 2020, 4, 14
- [4] B. Krause, P. Pötschke et al., *Energies*, 2020, 13, 394
- [5] B. Krause, P. Pötschke et al., *Journal of Composites Science* 2019, 3, 106
- [6] J. Luo, B. Krause, P. Pötschke et al., *Polymer*, 2017, 108, 513-520
- [7] M. Gnanaseelan, B. Krause, J. Pionteck, P. Pötschke et al., *Composites Science and Technology*, 2018, 163, 133-140