THERMOELECTRIC PROPERTIES OF HYBRID ZINC OXIDE–ORGANIC SUPERLATTICES DEPOSITED ON COTTON TEXTILE SUBSTRATES

A. J. Karttunen, M. Karppinen

Department of Chemistry and Materials Science, Aalto University,
P. O. Box 16100, FI-00076 Aalto, Finland
email: antti.karttunen@aalto.fi

Thermoelectric (TE) materials can be used to convert heat to electric energy via the Seebeck effect. There is currently a significant interest in producing flexible and efficient TE generator solutions for wearable devices and sensors.[1] In particular, a flexible TE generator integrated with light-weight and comfortable textile substrates could be an enabling platform for body-heat-based energy harvesting.[2]

Atomic layer deposition (ALD) is a highly controllable technique to deposit semiconducting inorganic materials directly on both yarns and textiles.[3] Combining ALD with molecular layer deposition (MLD) enables the fabrication of hybrid inorganic-organic materials with increased flexibility. We have deposited pristine zinc oxide (ZnO) and ZnO–organic superlattice thin films on a cotton textile using ALD/MLD and investigated their thermoelectric properties.[4] We have also investigated the thermal conductivity of the ZnO–organic superlattice thin films by combining density functional theory (DFT) with the phonon Boltzmann transport equation (BTE).[5]

The thermoelectric properties of our ZnO and ZnO–organic superlattice coatings are comparable to those for thin films deposited on conventional inorganic substrates. The ZnO–organic superlattice thin films moreover show enhanced resistance to mechanical strain, providing an exciting materials platform for further research towards TE/textile integration.

[1] Z. L. Wang, W. Wu, *Angew. Chem. Int. Ed.* **2012**, *51*, 11700.
[2] J. Bahk, H. Fang, K. Yazawa, A. Shakouri, *J. Mater. Chem. C.* **2015**, *3*, 10362.
[3] G. N. Parsons, in *ALD of Nanostructured Materials* (Eds: N. Pinna, M. Knez), Wiley-VCH, 2012, p. 271.
[4] A. J. Karttunen, L. Sarnes, R. Townsend, J. Mikkonen, M. Karppinen, *Adv. Electron. Mater.* **2017**, in press.
[5] Karttunen, A. J.; Tynell, T.; Karppinen, M. *Nano Energy* **2016**, *22*, 338–348.