3rd PRESS RELEASE
July 2021

For immediate release

Polymer-based thermoelectric materials for power generation as a replacement for rare earths

One of the objectives of InComEss Project is to develop innovative high-performance thermoplastic-based p-and n-type thermoelectric composites with enhanced Seebeck coefficients for their application in single or hybrid piezoelectric and thermopiezoelectric generators. 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 occurs, which is defined as thermoelectric voltage. This effect was first described in 1823 by the German physicist THOMAS JOHANN SEEBECK. The combination of n- and p-conductive materials is necessary for the construction of a thermoelectric module. Thermoelectric generators are characterised by a simple design, reliability and long service life, among other things because they have no moving parts and the associated wear and tear. Commercially available are thermoelectric generators based on metals, metal alloys, or metal oxides (e.g. lead or bismuth telluride).

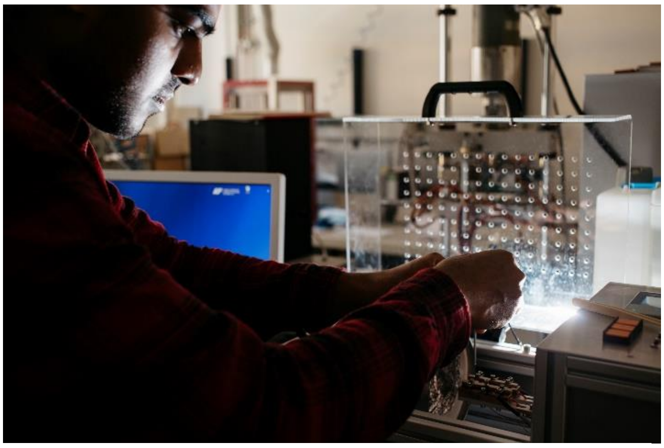

Figure 1: © Photo by Döring (IPF)

The focus for thermoelectric investigations at InComEss project partner, IPF Dresden, is on electrically conductive thermoplastic polymer composites (CPC). The advantages of polymer-based TE materials over typically used metal oxides are not only their better availability and cost efficiency, but also their ease of processing, mechanical flexibility, low density and low thermal conductivity. However, disadvantages include the low energy output and difficulties in obtaining CPC with n-type behaviour.

In this research topic, melt- or solvent-mixed composites of various thermoplastic polymers and different carbon-based fillers (e.g. carbon nanotubes (single-walled, multi-walled, nitrogen-, boron-doped), carbon nanofibres, carbon black, graphite, graphene nanoplatelets) are produced and various additives are added. The aim is to obtain both n- and p-conducting materials in order to be able to produce thermoelectric modules avoid of environmental harmful metals. In previous work, structure-property relationships for thermoelectric materials could be demonstrated. Thus, the incorporation of carbon nanotubes with n-type behaviour (e.g. nitrogen-doped MWCNTs) always leads to n-type composites. However, the combination of p-type SWCNTs with nitrogen-containing polymers, in particular, can also lead to composites with n-type behaviour.

A measuring stand was developed at the IPF to determine the thermoelectric properties. In addition to the thermoelectric voltage at different temperature differences, the electrical resistance and current can also be measured on the samples. The measurements can be carried out between room temperature and 110°C on solid specimens as well as on powders or liquids.

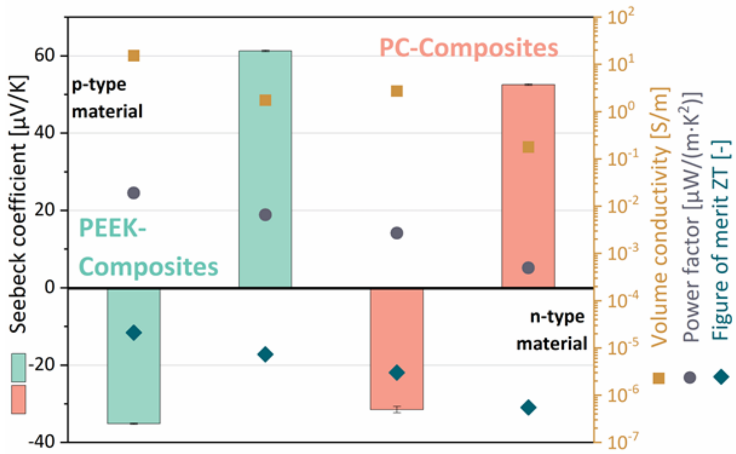

Figure 2: TE parameters of electrical conductive PC- and PEEK composites with the highest Seebeck coefficients

The focus of the InComEss project is on electrical conductive polycarbonate (PC) composites for the aeronautic use case and electrical conductive polyether ether ketone (PEEK) composites for the automotive use case. For both polymers, it has already been possible to develop both p-type and n-type materials that can be incorporated as legs into the thermoelectric generator. The development of n-type composites in particular is a great success, as such properties have not yet been described for these two polymers in the literature.

Work is currently underway on the design of the thermoelectric generator, which is tailored to the respective use case in aeronautic or automotive.

Details

Project title: INnovative polymer based COmposite systeMs for high efficient Energy Scavenging and Storage

Project ID: 862597

Start Date: 01/03/2020

Project Duration: 42 months

Project Consortium:

Follow us

For additional information please contact

Project Coordinator: AIMEN
Cintia Mateo | cintia.mateo@aimen.es

Dissemination & Communication Manager: Core Innovation
Antigone Nikolaidi | anikolaidi@core-innovation.com