

We will convert waste heat into electricity

EurekAlert

There is a great deal of waste heat in our society: in the exhaust from our cars, from our houses and from power plants and industry. It is therefore important to explore how to utilize this wasted energy. Power plants are already reclaiming this waste heat for district heating, but what if you could effectively produce electricity from waste heat?

"There are quite obvious benefits of this technology, but until now the technology has not been effective enough for industry to be involved. Some of the technological challenges are materials, processes and integration into existing systems. We hope that with this project we can get closer to bringing this technology to the market that ultimately may also help to reduce CO₂ emissions significantly," says Nini Pryds from the Fuel Cells and Solid State Chemistry Division who is the project coordinator.

The Danish Council for Strategic Research has granted nearly 18 million to the project OTE POWER (Oxide thermoelectrics for effective power generation from waste heat) for a period of 4 years. Project partners are Risø DTU, Aalborg University and Aarhus University in Denmark, Kyushu University of Japan and Caltech from the USA. In addition there are five partners from the industry, including a Danish company, Alpcon A/S, that develops and integrates thermoelectric generator modules to specific market segments and applications. All project participants can be seen in the infobox.

Heat difference becomes electricity

Thermoelectric materials work by exploiting a difference of temperature on each side of a semiconductor material. Electrons move from the hot side to the cold and thus transform heat into electricity. The principle is simple and the technology is not new. What is new is using oxide materials as the thermoelectric elements, materials which are well known from the fuel cells activity that has been a great commercial success at Risø.

The project has three major parts. The first part is the development of material (thermoelectric oxide materials of n- and p-type). The second part is looking at how to integrate the various components in a module that can convert heat into electricity. And in the latter part of the project the focus will be on integrating the module into a thermoelectric converter system. Risø DTU contributes 3 PhDs in the first part and a postdoc in the second part. A total of 5 PhDs and 2 postdocs will be involved in this project.

High demands for the materials properties

The requirements for a thermoelectric material are extremely tough. The material

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must have high thermoelectric power, be stable at high temperatures and also consist of non-toxic and inexpensive materials that can be easily shaped.

"And this is where the oxide materials came in as one of the strongest candidates. At Risø, we already know a lot about these materials due to our fuel cells and magnetic refrigeration research. The purpose of this project is to demonstrate that it is feasible to incorporate and build effective modules of high temperature thermoelectric materials in a conversion system", Nini Pryds elaborates.

The technology can potentially be used in many places. For example, the thermoelectric material can be mounted on a car's exhaust pipe or on top of a stove in the living room. When the material on one side comes into contact with the hot exhaust or the stove's hot metal, it will cause the electrons at this point in the material to have increased thermal motion, making the electrons move from the hot to the cold side generating electricity.

The generated electricity can then be used, for example, to charge the battery or even to generate power for a television that runs beside the stove.

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