A Novel Technique of Thermoelectric Conversion (Yeda)

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Summary

The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice versa. Thermoelectric effects are used in various applications, where heat energy is saved, that would be otherwise lost. Although the TE conversion efficiency is nowadays low (5-8%), the novel technique developed at Weizmann Institute, has a disruptive potential to change this market.Prof. Y. Imry and his team at Weizmann Institute came up with Thermal Electric conversion technique, based on a new TE device architecture which allows performance enhancement. The core invention is in the field of Bi-junction thermoelectric device architecture, having a thermoelectric gate interposed between two electric regions, leading to thermal electric conversion efficiency optimization.

Applications

Various TE devices will benefit from better TE efficiency, achieved by the developed conversion technique. The growing market for thermoelectric energy harvesters will reach $865 million by 2023. Current TE market is driven by consumer energy harvesting applications and some niche segments:

- Automotive energy harvesting applications, since around 40% of the energy produced by internal combustion engines is currently lost in heat through the exhaust.
- Wireless devices/sensors segment is forecasted to account for over a third of the overall market for thermoelectric harvesters and cooling by 2023.

Advantages

In order to drive down the thermoelectric module costs and facilitate broad deployment, TE has several barriers to overcome:

- low conversion efficiency;
- toxicity and low availability of chemical elements constituting part of the thermoelectric materials.

In this context, the main TE market challenges are reaching higher efficiencies using low cost thermoelectric materials. These challenges can be addressed by the proposed technology.

Technology's Essence

Prof. Y. Imry and his team at Weizmann Institute have developed novel bi-junction TE device, having a thermoelectric gate interposed between two electric regions, aiming at TE efficiency improvement. Thermoelectric efficiency depends on the figure of merit (ZT). The figure-of-merit curves, for the developed 3-T TE device configurations show that higher ZT should be achieved.The secret essence of the invented configuration is in using two independently adjustable input parameters - voltage and temperature - as drivers for optimizing device thermoelectric efficiency.

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