

## 熱電發電機之研發

### Development of Thermoelectric Generators (TEGs)



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#### 簡介 Abstract

熱電發電機 (TEG) 是運用熱電效應將熱 (溫度差) 直接轉換成電能的一種裝置。在生活中，有許多被廢棄的熱能，如：

- 工業熱能 (如工業高 / 低階廢棄熱能)
- 交通工具排放熱能 (如汽車尾氣)
- 環境熱 (如太陽熱能 / 溫泉地熱)
- 其他熱能 (如熱水管、住宅器具熱能)

如果能將這些熱能善加利用，即可成為再次使用的能源。

TEG 具有可靠性高、壽命長及環保等優點，而且，相比傳統的熱力發電機，它的體積小、可擴展，能在較小的溫差下生產電力。然而，它的效率不高，阻礙了它的應用發展。

Thermoelectric Generators (TEGs) are devices that can directly convert heat (temperature difference) into electricity. In our daily life, a lot of thermal energy is wasted, e.g.:

- Industrial heat (High / low quality waste heat)
- Transport vehicles (exhaust gas)
- Environmental heat (solar heat, hot spring)
- Others (hot water pipe, residential appliances)

If these heat sources are harvested well, they can be utilized again. TEGs have many advantages including high reliability, long lifetime, and environmental friendliness. Especially, compared to conventional heat engines, TEGs are compact, scalable, and can be easily driven by small temperature differences. However, its low energy conversion efficiency hindered its widespread applications.

#### 全球文獻記錄中功率密度最高 World record high power density

團隊結合了脈衝電鍍法及微細加工，在溫度差 52.5 K 之下製造出**功率密度高達 9.2 mW cm<sup>-2</sup>** 的熱電發電機，是文獻紀錄中電鍍微型熱電發電機之中最高。

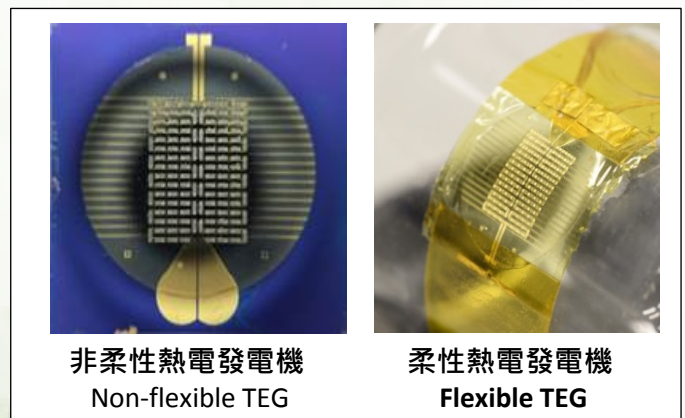
此外，柔性 TEG 更可應用在無線傳感器及微電子器件 (如可穿戴醫學傳感器及智能手表) 上，以收集人體之熱能來為設備供電。柔性可穿戴設備具有彈性，與皮膚貼合的更好，佩戴舒適度更佳。團隊目前正在致力於柔性 TEG 的開發。

該項技術目前正在申請一項美國專利。

The team developed thermoelectric generators (TEGs) by combining pulsed electroplating with microfabrication processes. It achieved a **power density as high as 9.2 mW cm<sup>-2</sup>** at a temperature difference of 52.5 K, **which is the highest value reported so far** for the electroplated micro-TEGs in the literature (*J Microelectromechan. Syst.* 25: 744-9).



更多項目資訊  
More information



Flexible TEGs could be used for thermal energy harvesting from the human body to power microelectronic devices (such as wearable medical sensors and wristwatches). They are very flexible, making them well adhered to the skin and comfortable for the users. The team is currently developing the flexible TEGs.

#### 可授權專利 Available Patent



Methods of fabrication of flexible micro-thermoelectric generators  
(US Patent Application: US 2017/0345989)