

# 基於無鉛鐵電材料的微型製冷器

## Lead-free Ferroelectrics Based Microrefrigerator

微型製冷器所用的固態製冷劑是製冷量優於4焦耳/克的環保無鉛鐵電材料

Electro-caloric microrefrigerators are invented based on lead-free ferroelectric refrigerants with a refrigeration effect better than 4 J/g

專利申請編號及國家：2010101469583 (中國)

### 特色與優點

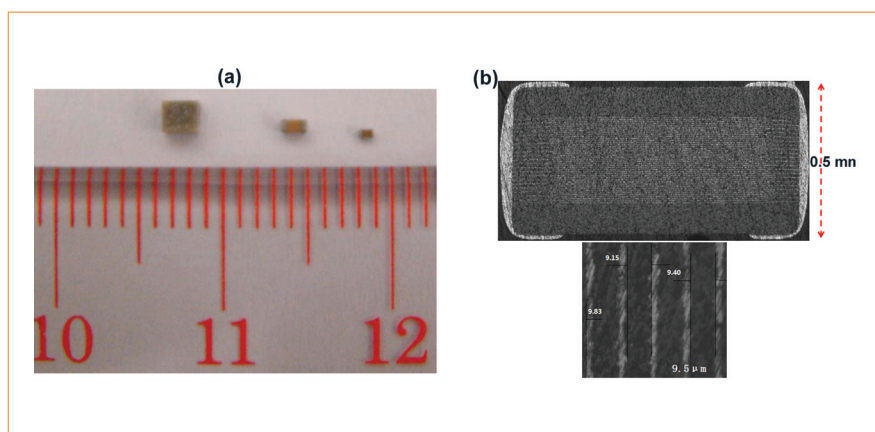
微型製冷器是一種由無鉛鐵電材料與金屬電極交替而成的多層結構。大小為0.5-2毫米。金屬電極層上施加40-300伏的周期電壓以實現優於4 焦耳/克的製冷量；能量轉換效率優於86%。

### 應用

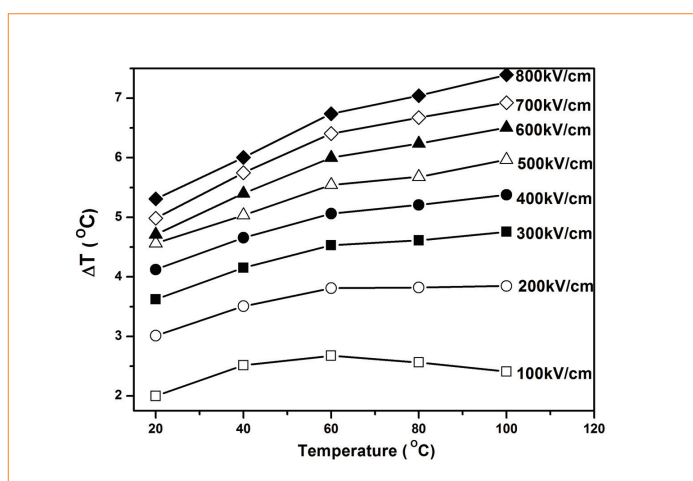
應用於微電子產品中大功率器件的降溫，可提高微電子產品的壽命及性能，降低能耗。製成雪櫃或空調器，可使醫院或電動汽車使用的製冷設備小型化和輕型化。

### 獎項

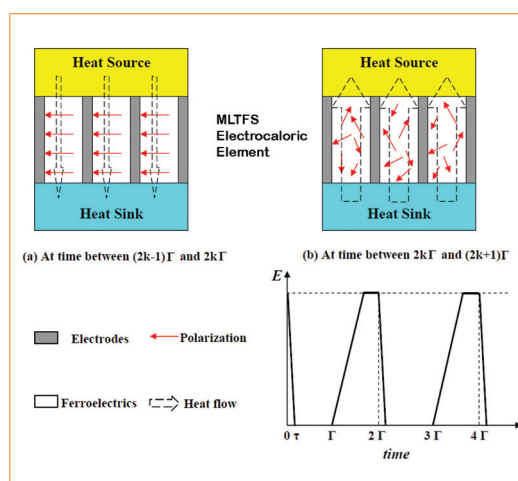
第40屆瑞士日內瓦國際發明展 — 金獎 (2012年4月)



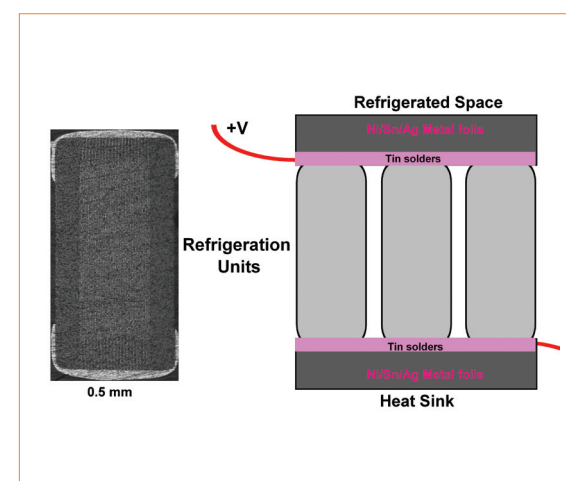
鐵電製冷單元(a)及其放大的內部結構(b)  
Size (a) and structure (b) of the refrigeration units.



無鉛鐵電製冷劑的製冷量  
Refrigeration effect of the lead-free ferroelectric refrigerants.



無鉛鐵電微型製冷器的工作原理  
Operation principles of the ferroelectric microrefrigerator.



無鉛鐵電微型製冷器的構造簡圖  
Schematic of the ferroelectric microrefrigerators

Patent Application No: 2010101469583 (China)

### Special Features and Advantages

The microrefrigerators consist of electro-caloric ferroelectric refrigeration units whose size is 0.5-2 mm. Each refrigeration unit has 20-500 layers of ferroelectric refrigerant films. The refrigerants are lead-free and achieve a refrigeration effect better than 4 J/g under applied voltages of 40-300 V. The energy efficiency of the microrefrigerator is 86%.

### Applications

The microrefrigerators are used for the cooling of hot spots in high-power micro-electronic components, devices and products. The ferroelectric refrigeration methods and the ferroelectric refrigerants developed in this project are used to make very light refrigerators and air conditioners that can be used in electric vehicles and hospitals.

### Award

Gold Medal - 40th International Exhibition of Inventions of Geneva, Switzerland (April 2012)

#### Principal Investigator

Dr Guangping ZHENG

Department of Mechanical Engineering

#### Contact Details

Institute for Entrepreneurship

Tel: (852) 3400 2929 Fax: (852) 2333 2410 Email: pdadmin@polyu.edu.hk