

# 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)

為了防止地球暖化和保護臭氧層，傳統機械製冷系統中的氟利昂或其替代製冷劑的使用會逐漸減少或會被限制。本發明是一種基於無鉛鐵電材料的高效固態製冷技術，可替代機械製冷技術並具有比機械製冷技術和其它製冷技術更為優異的能量轉換效率。本發明涉及無鉛鐵電材料的製備及其結構的設計，使之成為具有高製冷量的環保製冷劑。

### 特色與優點

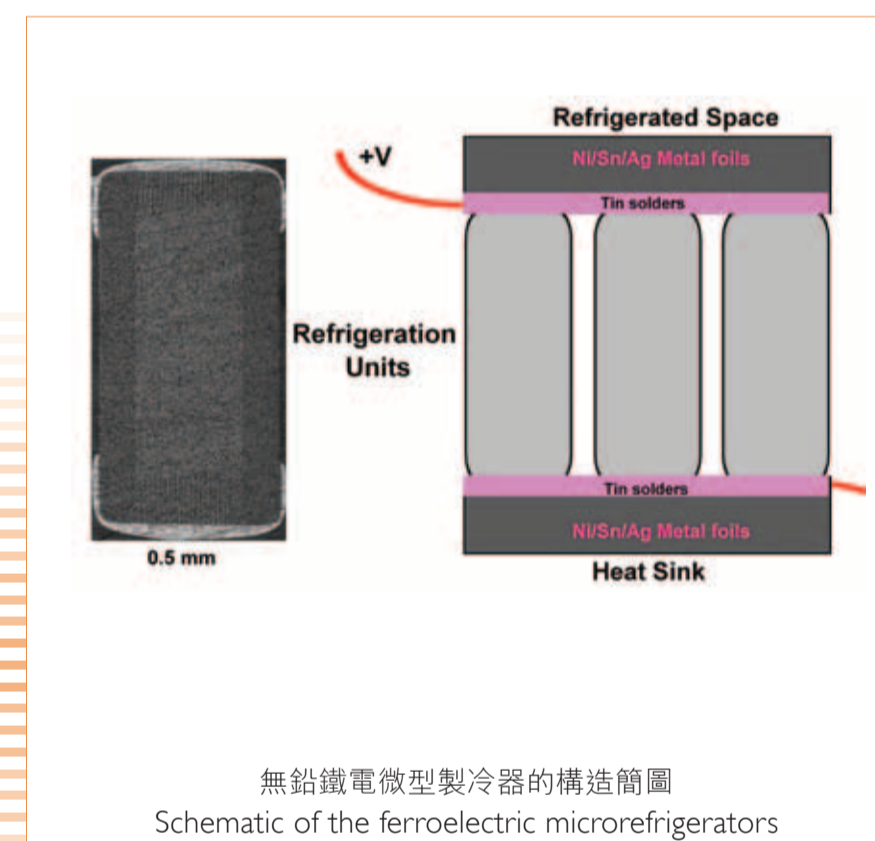
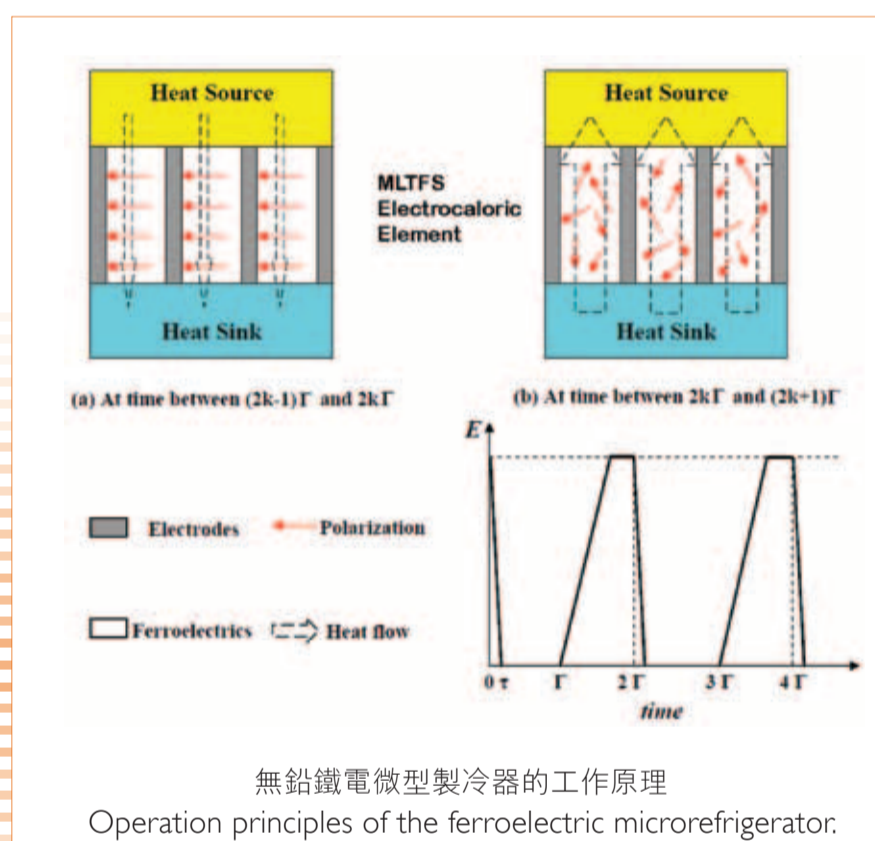
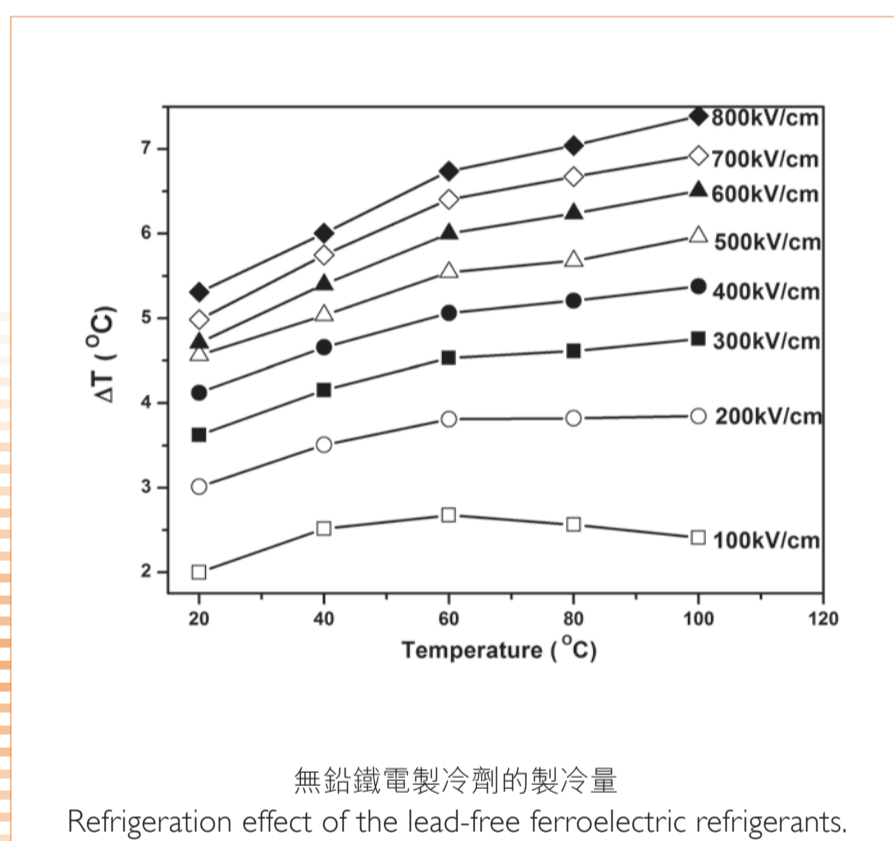
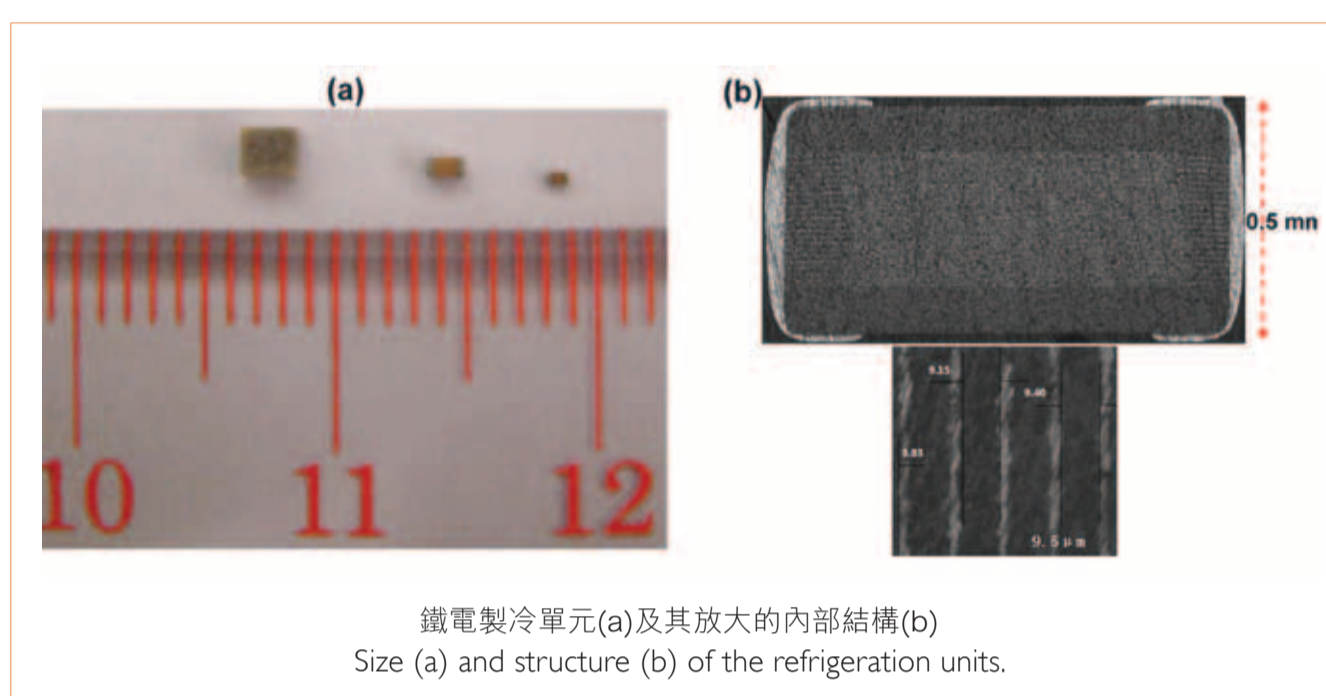
微型製冷器是一種由無鉛鐵電材料與金屬電極交替而成的多層結構。大小為0.5-2毫米。金屬電極層上施加40-300伏的周期電壓以實現優於4焦耳/克的製冷量；能量轉換效率優於86%。

### 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)



Patent Application No: 2010101469583 (China)

Novel refrigeration methods that can be used to replace the vapor compression technology are desirable because of the abolishment of the refrigerant Freon in the near future around the world. Compared with other refrigeration technologies, the electro-caloric ferroelectric refrigeration technology has advantages in refrigeration efficiency, cost and easy implementation in applications. To date, most of the ferroelectrics are not practically used as refrigerants for such refrigeration technology because of their small refrigeration effect or the use of materials containing lead. In this project we develop lead-free ferroelectric ceramics that are environmentally friendly and are practical to be used as microrefrigerator.

### 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.

### Awards

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

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