

課題番号 : F-21-UT-0109  
 利用形態 : 機器利用  
 利用課題名(日本語) :  
 Program Title (English) : Development of electret-enhanced pyroelectric energy harvester  
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 キーワード/Keyword : 切削、エレクトレット、焦電性、環境発電

### 1. 概要(Summary)

Electret-enhanced pyroelectric energy harvesting is studied towards high energy density and efficiency. Various pyroelectric materials are characterized for harvester design. Significant power density enhancement is verified with bulk PMN-PT (Lead magnesium niobate-lead titanate) sample.

### 2. 実験(Experimental)

#### 【利用した主な装置】

ブレードダイサー (DAD3650)

高密度汎用スパッタリング装置 (CFS-4ES)

#### 【実験方法】

Bulk pyroelectric ceramics are firstly cut by DAD3650, and then patterned with Cr/Au electrode with CFS-4ES. The pyroelectric cell is then characterized for Polarization-Electric-field loop and dielectric measurements.

A harvesting benchmark system is built to analyze the harvesting performance of different materials. Temperature of pyroelectric cell is fluctuated by sliding on a temperature gradient plate. A synchronized switch system is applied to enhance the power output in low frequency cases.

### 3. 結果と考察(Results and Discussion)

With a 7.5mm x 7.5mm x 0.5 mm PMN-PT cell, 500  $\mu\text{J}/\text{cm}^2$  per cycle is obtained with 0.02 Hz of 18  $^{\circ}\text{C}$  temperature difference, which corresponds to the energy density of 27.8  $\mu\text{J}/(\text{cm}^2\text{K})$  and scaled Carnot efficiency of 0.42%.

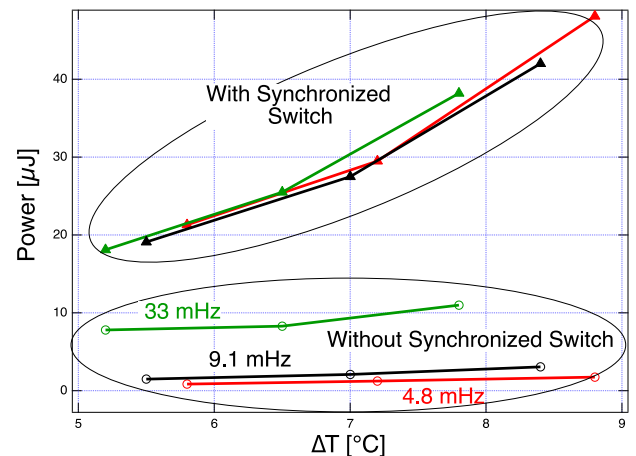


Figure 1. Power output comparisons between with/without switch cases for various frequencies.

Figure 1 shows the harvested power with/without the synchronized switch. Our electret-based pyroelectric generator with synchronized switch is proved to be effective in power enhancement from electric field of the electret. Consistent power can be realized by open circuit voltage increased with synchronized switch.

### 4. その他・特記事項(Others)

なし

### 5. 論文・学会発表(Publication/Presentation)

(1) Xie, H., Suzuki, Y., 日本機械学会熱工学コンファレンス 2021, オンライン, C213, 2021/10/10.

### 6. 関連特許(Patent)

なし