

課題番号 : F-21-UT-0108
 利用形態 : 機器利用
 利用課題名(日本語) :
 Program Title (English) : Development of push-button energy harvester with soft piezoelectret
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1. 概要(Summary)

Piezoelectret using space-charged porous polymers attracts much attention due to its high piezoelectric coefficient. Here we propose a novel all-polymer soft-X-ray-charged piezoelectret for push-button energy harvesting. The prototype is microfabricated using parylene-C membranes with patterned gap-control protrusions, dip-coated PEDOT:PSS (Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate) electrode and polymer electret. Up to 24.6 mJ electrical energy has been obtained with a single pushing force of 1.3 N: the piezoelectric coefficient d_{33} reaches 105 nC/N, 30 times higher than conventional MEMS-based piezoelectrets.

2. 実験(Experimental)

【利用した主な装置】

高速大面積電子線描画装置, マスク・ウエーハ自動現像装置群

【実験方法】

First, the piezoelectret design was optimized after considering the electret discharge issue. Critical discharge voltage was simulated and experimentally validated. Next, the optimized piezoelectret was microfabricated as shown in Fig. 1. The device was soft-X-ray charged and tested for its softness and power generation performance.

3. 結果と考察(Results and Discussion)

Power generation experiments were conducted by pushing the piezoelectret at a constant speed of 3 cm/s and stroke of 2.78 mm with a linear motor.

The maximum pushing force is as small as 1.3 N

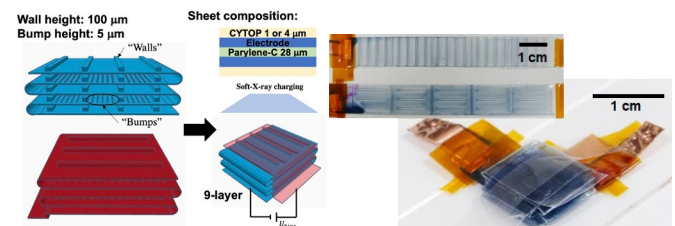


Fig. 1 Design and as-fabricated folded piezoelectret.

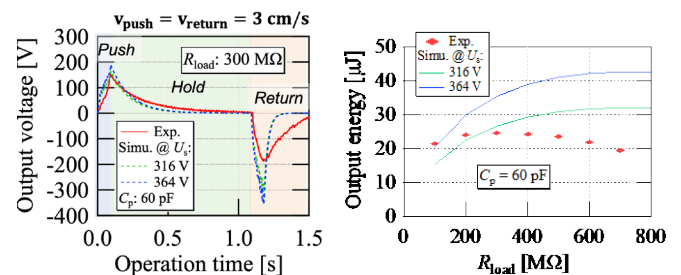


Fig. 2 Output voltage and output energy.

with a capacitance change of 356 pF. It is shown from Fig. 2 that the energy density is 36 $\mu\text{J}/\text{N}/\text{cm}^3$, which is much higher than commercialized push-button energy harvesters.

4. その他・特記事項(Others)

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5. 論文・学会発表(Publication/Presentation)

Lu, J., and Suzuki, Y., "All-polymer Soft-X-ray-charged Piezoelectret for Push-button Energy Harvester," *21st Int. Conf. Solid-state Sensors, Actuators, and Microsystems (Transducers '21)*, Online, B2-225e, 22, June 2021.

6. 関連特許(Patent)

なし