

課題番号 : F-17-UT-0069
 利用形態 : 機器利用
 利用課題名(日本語) :
 Program Title (English) : Soft X-ray Charged Piezoelectret with Embedded Electrodes
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 キーワード/Keyword : リソグラフィ・露光・描画装置, Flexible Piezoelectret, Soft X-ray charging

1. 概要(Summary)

A flexible piezoelectret energy harvester with embedded electrodes is proposed. With the aid of soft X-ray charging and high-performance electret CYTOP-M, output power of 2.8 μJ has been obtained for 0.6 mm displacement in 0.4 s, with the max applied mechanical force as low as 0.9 N and piezoelectric coefficient d_{33} as high as 16000 pC/N.

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, ブレードダイサー

【実験方法】

20 μm -thick parylene-C layers with a Cr/Au/Cr electrode are used as the membrane. 200 μm -high SU-8 pillars are patterned on the parylene-C layer by photolithography. After detachment from the wafer, the chips are dip-coated with high-performance electret CYTOP-107M (Asahi Glass), with the coating thickness of 7 μm on each surface. Finally, stacked 4-layered structure is formed and charged with soft X-ray charging.

3. 結果と考察(Results and Discussion)

As shown in Fig. 1, thin-film electrodes are integrated into the multi-layered structure, so that the bias voltage is directly applied to each layer during the soft X-ray charging. Power generation experiment is made using a setup shown in Fig. 2. The 4-layered structure is poled using soft X-ray charging with bias voltage of 600 V for 30 min. Up to 100 V is obtained for 0.6 mm displacement in 0.4 s, which corresponds to 2.8 μJ output energy. The effective Young's modulus is as low as 15 kPa, so that the maximum applied force is as low as 0.9 N. This leads to extremely-large d_{33} of 16000 pC/N, which is even higher than cellular PDMS.

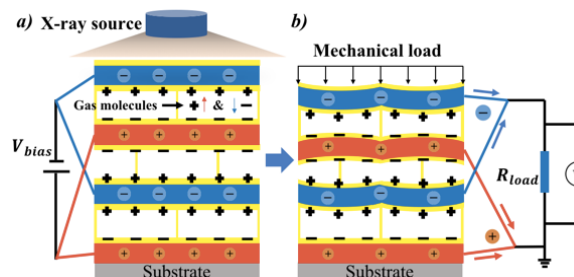


Figure 1. Multi-layered piezoelectret structures with embedded electrodes. a) Charging, b) Operation.

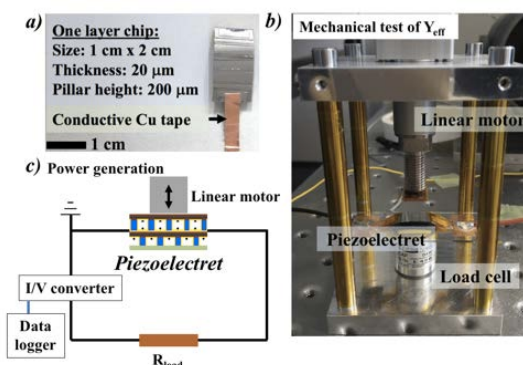


Figure 2. a) Single layer chip dip-coated by CYTOP. b) Measurement of effective Young's modulus using a load cell. c) Power generation experiment.

4. その他・特記事項(Others)

なし

5. 論文・学会発表(Publication/Presentation)

- (1) J. Lu & Y. Suzuki, 16th Int. Symp. on Electrets (ISE16), Leuven, Belgium, Sept., 2017.
- (2) J. Lu & Y. Suzuki, 31st IEEE Int. Conf. on Micro Electro Mechanical Systems (MEMS2018), Belfast, pp. 646-648 (2018).

6. 関連特許(Patent)

なし