課題番号　　:F-16-UT-0029
利用形態　　:機器利用
利用課題名(日本語)　　:
Program Title (English)　:Development of Piezoelectret Energy Harvester
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1. 概要(Summary)

A multilayered piezoelectret structure with embedded electrode is proposed, which can be efficiently poled with soft X-ray charging. With the aid of embedded electrodes, the bias voltage is directly applied to each unit cell, rather than divided and distributed to multiple layers. With an early PTFE-based prototype, output power of 0.5 μJ has been obtained for 0.3 mm displacement in 0.2 s.

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】

Firstly, an aluminum electrode is sputtered onto a 0.2 mm-thick PTFE film. Each film is bonded to a 0.4 mm-thick PTFE plate, in which pillar structures are formed by machining. This is followed by stacking and adhering five layers to form the multilayered structure with embedded electrodes. The bias voltage is directly applied to each layer with the soft X-ray irradiation [1] as shown in Fig. 1.

3. 結果と考察(Results and Discussion)

An electromechanical model based on the electrostatic model (Fig. 2) and the beam deflection theory is developed. Even with our early prototype using PTFE, where PTFE surface charge density is merely 0.05 mC/m^2, output power of 0.5 μJ has been obtained for 0.3 mm displacement in 0.2 s.

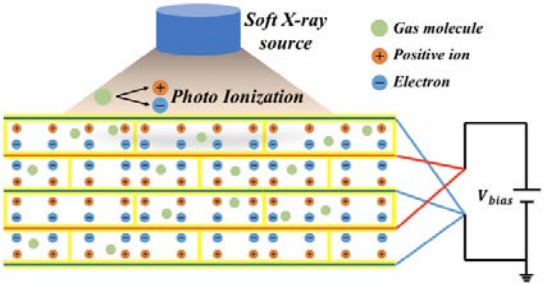

Fig. 1: Soft X-ray charged piezoelectret with embedded electrode.

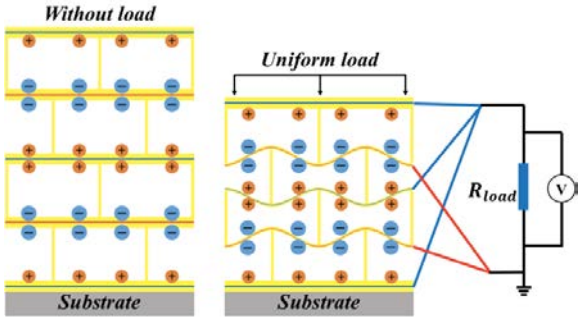

Fig. 2: Electro-mechanical modeling of the piezoelectret-based power generation.

4. その他・特記事項(Others)

参考文献: [1] K. Hagiwara et al., IEEE Trans. Dielectr. Electr. Insul., Vol. 19, pp. 1291-1298 (2012).

5. 論文・学会発表(Publication/Presentation)

(1) J. Lu, H. Cho, and Y. Suzuki, 16th Int. Workshop on Micro and Nanotechnology for Power Generation and Energy Conversion Applications (PowerMEMS 2016), Paris, (2016). Also, J. Phys.: Conf. Ser., Vol. 773, No. 012031 (2016).

(2) 陸嘉, 趙恒竣, 鈴木雄二, 日本機械学会熱工学コンファレンス 2016, 松山, 2016 年 10 月 22 日-10 月 23 日, H125.

6. 関連特許(Patent)

なし。