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*Supporting Information*

# Self-powered operational amplifying system with a bipolar voltage generator using a piezoelectric energy harvester

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We conducted the linear static analysis to compare our harvester with a single layer harvester which has the same thickness of PZT ceramic using ANSYS v17.2 (type of element: SOLID186 with 20 nodes). To be compared at the same condition, the same bending stiffness was set and therefore, the thickness of the substrate was 0.13 mm, not 0.2 mm (the same total thickness as our harvester). In this simulation, it was assumed that the substrate and the PZT are perfectly bonded and the transverse load of 1 N was applied to the tip of cantilever beam. When the force was applied in Figure S1, the single layer type harvester showed the tip displacement of 1.032 mm and the strain energy stored in PZT was 0.32 mJ. On the other hand, our harvester showed the tip displacement of 1.048 mm and the strain energy was 0.47 mJ. The reason why two harvesters have difference of electrical output performance is the distance from a neutral axis. In the case of single layer, a neutral axis is located near the PZT layer while a neutral axis is located at the center of the substrate in our harvester. In other words, the neutral axis of our harvester is farther from the PZT layer and it makes higher output. This result stems from the fact that the farther the distance between the PZT layer and the neutral axis is, the higher electrical output performance is obtained. Thus, it is concluded that our harvester is a better model for harvesting energy than single layer type harvester.

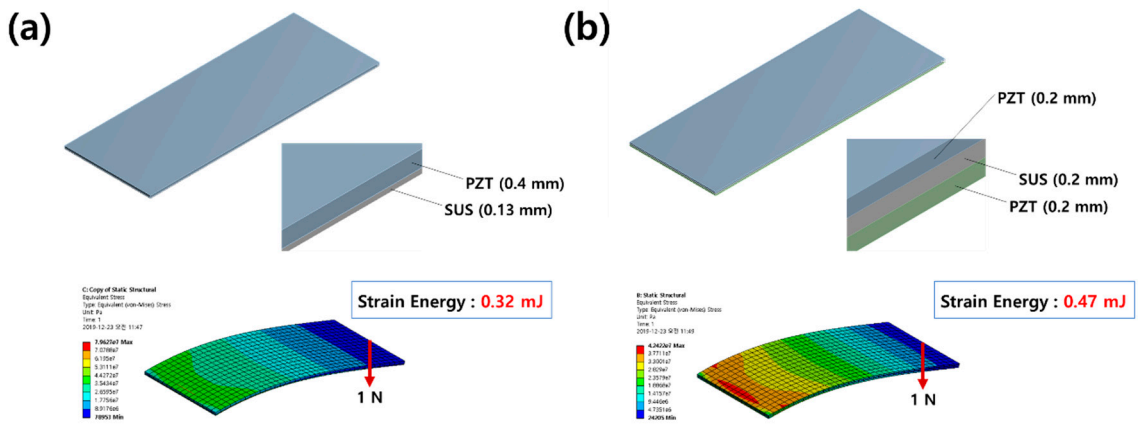


**Figure 1.** Linear static analysis (**a**) Single layer type piezoelectric energy harvester (**b**) Suggested piezoelectric energy harvester.