An electret-based energy harvesting device with a wafer-level fabrication process

This paper presents a MEMS energy harvesting device which is able to generate power from two perpendicular ambient vibration directions. A CYTOP polymer is used both as the electret material for electrostatic transduction and as a bonding interface for low-temperature wafer bonding. The device consists of a four-wafer stack, and the fabrication process for each wafer layer is described in detail. All the processes are performed at wafer scale, so that overall 44 devices can be fabricated simultaneously on one 4-inch wafer. The effect of fabrication issues on the resonant frequency of the device is also discussed. With a final chip size of about 1 cm², a power output of 32.5 nW is successfully harvested with an external load of 17 MΩ, when a harmonic vibration source with an RMS acceleration amplitude of 0.03 g (~0.3 m s⁻²) and a resonant frequency of 179 Hz is applied. These results can be improved in an optimized design.

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