What are piezoelectrics? And how does it work?

While seeking other solutions to this problem, investigators, specifically from NASA (4), they inferred that the development of light energy harvester devices with outputs of high power and low cost was essential. It was obtained information of piezoelectric material sensors, which were a way to collect through vibrations generated by air vehicles. In previous investigations, they had nano-generators of simple layers of MoS2, that resisted high tensions, and at the same time were light, but they believed it could be obtained more efficiency, idea where they were right, and it was proposed the idea of a piezoelectric energy producer that was light and highly effective with the same materials.

With investigations previously done by the team, and these bases of the main problems and partial solutions by NASA (5), it was chosen to go deeper and implement a new generation energy more efficient, grounded in a Ph.D dissertation, it was obtained information of piezoelectric energy harvester, being these ideal due to their performance, which is good in small quantities while moving.

It was reached to the idea of using piezoelectric technology, due to the environment generated during the flight, there is mechanical vibrations, this technology can operate with a great quantity inside the aircraft, in non busy area like the parts beneath the seat, services doors, generating that way, and besides reducing wiring in considerable amount.

Piezoelectrics are minerals that generate energy when they deform. The materials of this are regularly no effective if they don't produce electricity, but using these manufactured components specially for this method, they could be implement in a lot of parts of the aircraft.

This components are capable to generate energy for another components with only vibrations caused by minimum air currents or accelerations from 0.05 G to 0.3 G [6]. For this reason this will be implemented in parts of the aircraft where vibrations are bigger like seats or wings. This components have a very low price, so price ain't a problem. Also, manufacturing them is really simple, if any problem or failure is presented replacing them is a very viable option.

According to Leon, E. [6] this devices made by them are based in an insulating of silicium (SOI), silicon wafer. The layer of the device is used to define the beam and the bulk coat is used for inertial mass. On top of the beam, a layer of aluminum nitride forms the transducer piezoelectric. The layer of the piezoelectric is squashed between two metal layers that form the electrodes Ti/Pt. The materials of the piezoelectric consists of silicon material, silicium oxide SiO2, piezo material, capacitor, CMOS integrated circuit, and Ti/Pt electrode.

The piezoelectric harvesters that will be used [6], have a quadratic shape and in the center it has a trapezoidal shape and rounded corners. This design was evaluated in a FEM simulation, it has a uniform distribution of stress over all the layer. In this way, a higher charge density is generated and therefore, it is a more efficient device. In this design an increase in the power of the 60% was obtained. The total volume of one of this is 12.9mm^3 (5mm*5mm*0.516mm)
and 1.54mm3 (1mm×3mm×0.516mm) for the functional structure composed by the cantilever and the inertial mass. To obtain the results of the piezoelectric harvesters the simulator COMSOL MULTIPHYSICS. It was simulated with resistors from 50KΩ to 950KΩ, they were used to find the optimal value where the extracted power reaches a maximum value of 0.32μW and 1.3μW for a 0.1 G and 0.2 G of acceleration. The effective power density is 665.4μW/〖cm〗^3 for a vibration acceleration of 0.2 G and a frequency of 575 Hz, and a voltage from 0.75V to 1V is obtained.