Micro piezoelectric energy harvester fabricated with PZT thin-film using aerosol deposition method

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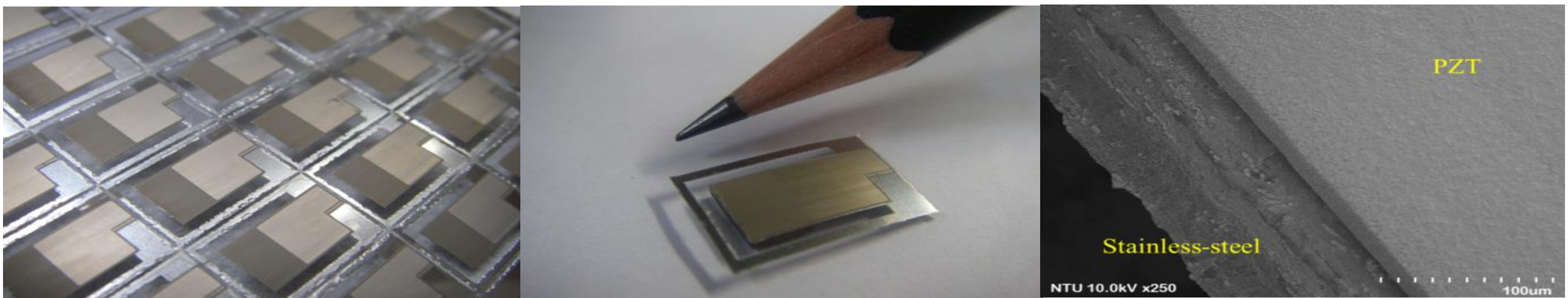
Internet of Thing (IoT) has been recognized as next thing big for semiconductor industry. Before 2020, there will be billions of connected intelligent devices linked with internet and interact with internet of people. For IoT devices in remote area, installed in difficult to reach locations, or installed on rotating machines which wiring is not possible, batterrties are usually the only solution to power this kind of devices. However, the service and matainanace costs for battery operated devices are usually high. Nevertheless, energy harvesting technologies to havest energy from ambient enviroment is therefore promising to replace batteris in these devices.

The piezoelectric micro energy harvesters (PMEH) or so called MEMS generators which can scanvege power from ambient vibrations has been an important research topic in the past decade. With the advancement of PMEH and with the SOC (system on chip) or SIP (system in package) technologies, it is possible to see a self-powered IC (integrated circuit) in near future. It is also possible to replace batteries in the applicaitons where wiring is not possible and batteries replacement is difficult, for instaces, the tire pressure monitoring sensors on cars and the packemakers embedded in the human body.

The performance, including the output votlage and output power for PMEHs has been steadily improved in the last decade. With the high quality PZT (lead zirconate titanate) thin-flrm deposited with a home-made aerosal deposition chamber and the stainless subtrated based micro fabrciation processes, high output power with highly reliable PMEHs has been succesfully fabricated. The output power of a cantilever type bi-morph PMEHs with a dimension of 8×6 mm chip aera has been acheived 425μW under a 1g vibration level at 143.25Hz.

In this presenation, the aerosal deposition method and the analsysis of the PZT thin-films deposited will be detailed[1]. The fabrication process and design consideration of using stainless steel substrates instead of conventional silicon substrates will also be presented[2]. The failure modes of PMEHs under high vibration levels will also be discussed. A self-powered SSHI (synchoronized swichting on inductors) non-linear interafacing circuit has also been sucefully integrated with the PMEH[3]. The results and considerations of the non-linear interafcing circuit and PMEH integration will also be presented.



(a) (b) (c)

Fig. (a) The PMEH devices fabrciated on a stain-less subrate (b) A single PMEHs device with the dimension referenced with a pencil tip. (c) The SEM photo of the cross-section of the PZT thin-film on stain-less substrate.