微系統智慧環境感知中樞

MEMS Environment Sensing Hub

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Low power miniaturized sensors and actuators are the key components of an Internet of Things (IoT) platform to improve the quality of life. In particular, environmental sensors can be deployed in the field (home/factory/city) for monitoring the temperature, pressure, humidity, and air/water quality about the surroundings. Such a valuable information can be analysed by the data scientists with artificial intelligence (AI) methods for identifying potential risks, establishing corresponding strategies, and reporting improvements of the entire infrastructure.

To address this issue, we attempted to develop advanced microsystem technologies to integrate various sensors into an autonomous environmental sensing hub with low noise and low power electronics. At present, our great accomplishments include: (i) a monolithically integrated pressure/humidity/temperature sensors based on CMOS-MEMS technology [1], (ii) a low power piezoelectric MEMS oscillator-based air quality sensor [2], (iii) a beta-human chorionic gonadotropin biosensor based on field-effect transistors [3], (iv) a DNA sensor beyond the Debye screening length using CMOS [4], (v) a novel vertically stacked tactile sensor with hollow structure [5], (vi) a ingestible polysaccharide battery coupled with a self-charging nanogenerator [6], and (vii) a novel surface acoustic wave resonator and a synthesized filter for wireless data communication [7]. The pictures of the developed sensors and actuators are summarized in Fig. 1.

Our team have published 43 and 35 international journals and conference papers and applied 8 and 5 US/TW patents in 2020 and 2021, respectively. Moreover, our research outcome has attracted leading companies in the semiconductor industry for extensive cooperative projects and technology transfer. Currently, we have 14 cooperative projects and received over 8.355 million NTD technology transfer funds. Please refer to Fig. 2 for details.

References

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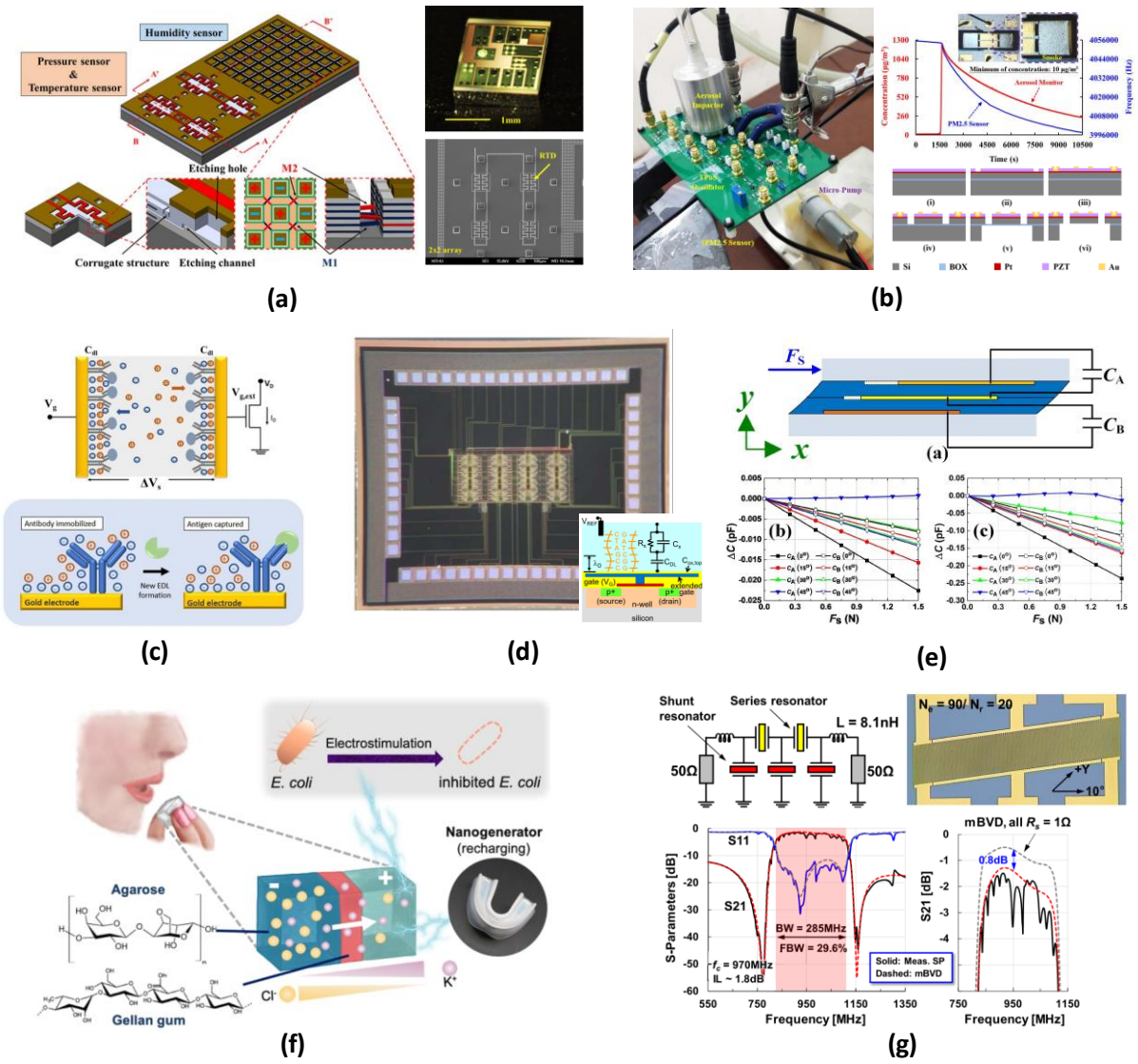

Fig. 1: Implemented MEMS devices for an enviromental sensing hub: (a) integrated pressure/humidity/temperature sensors in CMOS [1], (b) MEMS oscillator based air quality sensor [2], (c) β-hCG bio sensor [3], (d) CMOS-based DNA sesnor [4], (e) novel vertically stacked tactile sensor [5], (f) polysaccharide battery coupled with a self-charging nanogenerator [6], (g) novel surface acoustic wave resonator and a synthesized filter [7].

Item	2020	2021	Summary
Published papers (Journal+ Conferences)	43	35	78
# of patent application	8	6	14
Tech. transfer fund (NTD)	4.98M	3.375M	8.355M
# of industry-Univ. cooperative project	9	5	14

Fig. 2: Summary of the research outcome.