

# Batteryless NFC Based Flexible Smart Packaging for Meat Quality and Open Status Inspection

Haoyu Zhou, Siying Li, Sujie Chen, Xiaojun Guo \*

\* Department of Electronic Engineering, Shanghai Jiao Tong University, 800 Dongchuan Road, Shanghai 200240, China (x.guo@sjtu.edu.cn)

## Abstract

In this work, a batteryless near field communication (NFC) based flexible smart packaging patch was implemented for inspecting the freshness of the meat and the open status of the packaging. The system consists of an NFC chip, a flexible ammonia sensor and a flexible anti-open sensor as shown in Fig. 1. The designed NFC chip consists of analog front-end as sensor interfaces, wireless transmission module for data exchange with smart phone and an EEPROM for data storage. The wireless communication is compatible with ISO14443 protocol and the chip communicates in passive mode of NFC. The NH<sub>3</sub> sensor was fabricated on polyethylene terephthalate (PET) using dimethyl sulfoxide (DMSO) doped poly(3,4-ethylene dioxythiophene): poly(styrenesulfonate) (PEDOT:PSS) film as sensitive material [1,2]. The anti-open sensor was fabricated on fragile paper using PEDOT:PSS to form the memory code circuit [3]. Ultra-low power consumption of the sensors allow the whole system to be operated under batteryless conditions. Fig. 2(a) shows that the measured response of the NH<sub>3</sub> sensor agrees well with the that obtained via the Keithley source meter 6430. The anti-open sensor readout results at ‘open’ and ‘unopen’ status via NFC also remain very stable under thermal endurance test for one week.

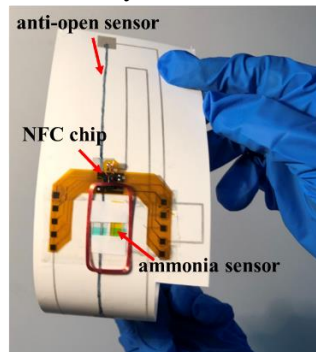


Figure 1: Photo image showing the developed smart packaging patch consists of an NFC chip, a flexible ammonia sensor and a flexible anti-open sensor

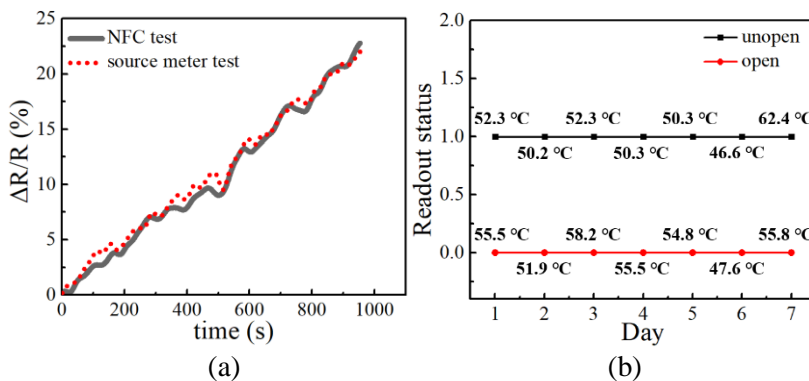


Figure 2: (a) Comparison of the measured response of the NH<sub>3</sub> sensor with the that obtained via the Keithley source meter 6430; (b) Thermal endurance test results of the anti-open sensors at 'open' and 'unopen' status via NFC.

## References

- [1] Li, S.; Chen, S.; Zhou, H.; Zhang, Q.; Lv, Y.; Sun, W.; Zhang Q.; Guo, X. : Achieving Humidity-Insensitive Ammonia Sensor Based on Poly(3,4-ethylene dioxythiophene): Poly(styrenesulfonate), *Organic Electronics*, Vol. 62, pp. 234-240, 2018.
- [2] Li, S.; Chen, S.; Zhuo, B.; Li, Q.; Liu, W.; Guo, X.: Flexible Ammonia Sensor Based on Pedot:pss/Silver Nanowire Composite Film for Meat Freshness Monitoring, *IEEE Electron Device Letter*, Vol. 38, No. 7, pp. 975-978, 2017.
- [3] Wang, R.; Chen, Feng, S. L; Li, Q.; Hu, W.; Liu W; Guo, X. : Stable Fully-Printed Polymer Resistive Read-Only Memory and Its Operation in Mobile Readout System, *Organic Electronics*, Vol. 27, pp. 259-265, 2015.