# ENABLING TECHNOLOGIES FOR A FLEXIBLE TAG GAS SENSING SYSTEM IN FOOD LOGISTICS APPLICATIONS

Mazzolai B., **Raffa V.***, Mattoli V., Dario P.
*Scuola Superiore Sant'Anna, CRIM Lab, P.zza Martiri della Libertà 33, 56127 Pisa, Italy*
Zampolli S., Elmi I., Piras E., Cardinali G.C.
*CNR – IMM Sezione di Bologna, Via P. Gobetti 101, 40129 Bologna, Italy*
Abad E.
*Fundación Tekniker, Avda. Otaola 20, 20600 Eibar/Guipúzco, Spain*
Becker T., Krenkow A.
*EADS Deutschland GmbH, Corporate Research Center, 81663 München, Germany*

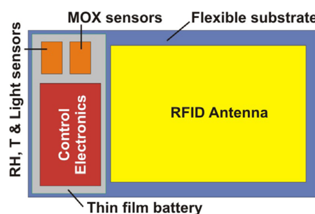
**Abstract**

In the framework of the "GoodFood" Integrated Project (IP) [1], a flexible tag gas sensing system with RFID communication capabilities for food logistics is being proposed. This visionary application requires the development and optimization of several Micro System Technologies (MST), like Flexible Circuits Technologies (FCT) [2], micromachining of ultra-low power consumption sensor substrates, and addressing specific integration issues.

FCT refers to a group of additive processes for the construction of multi-layers flexible circuits, commonly based on the use of a polyimide as row material. We will describe the procedure implemented for the fabrication of a multilayer high density integrated circuit, based on the following main steps: 1) Deposition of the dielectric interlayer; 2) Patterning to open the vias; 3) Deposition of the metallic layer by Physical Vapor Deposition (PVD) for thin conductive films (<1µm) or electrodeposition for thick conductive films (<20µm) 4) Photolithographic patterning of the metallic layer (lift-off process or chemical etching).

These steps can be repeated until obtaining the desired number of layers, followed by the final curing and passivation. A 'multitasks' photosensitive polyimide was used, suitable to work as a photodefinable dielectric interlayer, as a passivation layer for packaging as well as a resist for patterning of the metal layer, offering excellent resolution (<80µm) and aspect ratios > 1. FCT is suitable to integrate the RFID antenna and the electrical interconnections into a flexible substrate in a monolithic way.

Commercial or custom ICs, including control electronics and metal oxide semiconductor (MOX) gas sensors, can be integrated by adapting conventional assembling technologies. However, several constraints on power consumption, mechanical stability and encapsulation issues have to be faced for MOX sensor integration in FCT. For this purpose, new ultra-low power consumption, front-side silicon bulk micromachined hotplates are being designed. The small dimensions of the chip (0.5x1.0 mm$^2$ for a 4-sensor array) and the very low power consumption (< 5 mW for 400°C) will allow the use of MOX sensor technology on flexible, thin-film-battery powered RFID tags. The design and thermo-electrical simulations of these micro-hotplates will be shown, together with the first realized test structures.




Vision of a sensing flexible tag for food logistic applications: main functional blocks

REFERENCES

1. http://www.goodfood-project.org
2. F.Barlow et al, Microelectronics Reliability, Vol. 42, Issue. 7 (July 2002), 1091-1099

***CORRESPONDING AUTHOR:*** *E-mail: simo@mail-arts.sssup.it, Ph: 050883414, Fax 050883497*