OWiC microLINKs: Microscopic Optical Smart Tags for Connecting Digital Content to the Physical World

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Primary CNF Tools Used: Heidelberg Mask Writer - DWL2000, ABM Contact Aligner, Zeiss SEMs, Oxford 100 ICP Etcher, Oxford 81 Etcher, Oxford Cobra Etcher, PT770 Etcher, AJA Sputter Deposition, Oxford PECVD, SC4500 Evaporator, Oxford ALD

Abstract:

OWiC Technologies is a Cornell spinout startup commercializing a new class of unique ID tags called microLINKs to securely, intelligently, and wirelessly connect the physical and digital worlds. The microLINKs tags are based on the core technology of Optical Wireless Integrated Circuits (OWiCs), that are effectively in-visible, intelligent, and integrated with a built-in optical power and communication system made of photovoltaics/ microLED. A microLINK tag functions in a way analogous to an RFID tag but uses light for power and communication instead of RF. When light is directed toward a microLINK, it will blink out a unique 64-bit ID that can be read out with a handheld reader. The code, in conjunction with a cloud database of tags and links, connects to digital content on a smartphone, tablet, or, in the future, smart glasses. We use a wide range of tools in the Cornell NanoScale Facility (CNF) to produce these microLINK tags.

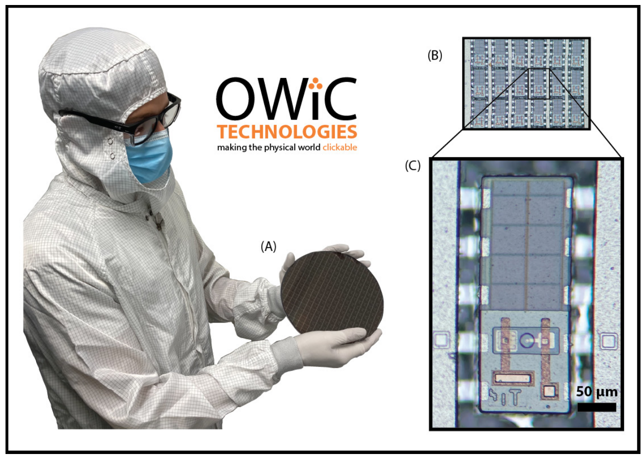

Figure 1: (A) An 8-inch wafer of microLINK integrated circuits from a commercial foundry. (B) An array of integrated microLINK tags. (C) An integrated microLINK tag prior to removal from the substrate. This microLINK tag design is approximately 100 × 300 microns.

Summary of Research:

The entire microLINK device is approximately 100 × 300 microns in size and is composed of photovoltaics, a circuit for on board digital logic, and a microLED. The photovoltaics and integrated circuit are designed in a 180 nm silicon-on-insulator (SOI) complementary metal-oxide-semiconductor (CMOS) process available from a commercial foundry. The circuit creates a series of electrical pulses that encode a unique identification code that are used to drive the microLED, producing the output light. These circuits are received from the commercial foundry as a wafer shown in Figure 1(A). Separately, we produce light emitting elements in the CNF primarily out of gallium arsenide heterostructures. These two components — the CMOS components and microLED — are then integrated using heterogenous integration methods. Methods for producing these devices are detailed in references below [1-4].

Figure 1 A shows an array of integrated microLINK devices before being removed from the substrate is shown in Figure 1 (B) as well as a zoomed in image of a single device, Figure 1 (C).

References:

[1] A. C. Molnar, S. Lee, A. Cortese, P. McEuen, S. Sadeghi, S. Ghajari, in 2021 IEEE Custom Integrated Circuits Conference (CICC) (2021), pp. 1-6.

[2] S. Lee, A. J. Cortese, A. P. Gandhi, E. R. Agger, P. L. McEuen, A. C. Molnar, A 250 μm × 57 μm Microscale Opto-electronically Transduced Electrodes (MOTEs) for Neural Recording. IEEE Trans. Biomed. Circuits Syst. 12, 1256-1266 (2018).

[3] S. Lee, A. J. Cortese, A. Mok, C. Wu, T. Wang, J. U. Park, C. Smart, S. Ghajari, D. Khilwani, S. Sadeghi, Y. Ji, J. H. Goldberg, C. Xu, P. L. McEuen, A. C. Molnar, Fabrication of Injectable Micro-Scale Opto-Electronically Transduced Electrodes (MOTEs) for Physiological Monitoring. J. Microelectromechanical Syst. 29, 720-726 (2020).

[4] A. J. Cortese, C. L. Smart, T. Wang, M. F. Reynolds, S. L. Norris, Y. Ji, S. Lee, A. Mok, C. Wu, F. Xia, N. I. Ellis, A. C. Molnar, C. Xu, P. L. McEuen, Microscopic sensors using optical wireless integrated circuits. Proc. Natl. Acad. Sci. 117, 9173-9179 (2020).