



MEDIA RELEASE

Unravelling the mind-body connection with power-efficient IC chip jointly developed by A*STAR IME, NTU and NUS

1. Singapore, 21 Nov 2013 - Despite the advances in neuroscience research, the human brain remains a complex puzzle with questions unanswered on how it controls human behaviour, cognitive functions and movements. Scientists from A*STAR Institute of Microelectronics (IME), Nanyang Technological University (NTU) and National University of Singapore (NUS) have jointly developed and demonstrated an integrated circuit (IC) chip with record-low power consumption for direct recording of brain activities. This breakthrough minimises the patient's exposure to electromagnetic radiation and heat during the recording process, making it possible to integrate greater number of channels (>100 channels) to acquire more comprehensive profile of brain signals, paving the way to unlock the mystery behind the complex mind-body connection.
2. Neural recording system is a vital tool to acquire and process brain signals, and is also applied in artificial limb control (or neural prosthesis) treatments for paralyzed patients. The system comprises multiple electrodes for data acquisition and is implanted within the skull during the operation. The implantability of the system places tight limits on its size and power consumption, while at the same time demanding sufficient performance to record good quality data.
3. The joint team from IME, NTU and NUS demonstrated for the first time, a 100-channel neural-recording IC which has a record low power consumption of 0.94 μW per channel and the ability to deliver high quality signal recording. Compared to current state-of-the-art neural recording ICs, the new Singapore-developed IC can operate at just 0.45 V supply voltage, half of what is typically required to achieve similar performance. The new 100-channel IC chip has also successfully recorded the neural signals of an anesthetized Sprague-Dawley rat, bringing the innovation a step closer to clinical deployment.

4. Dr Je Minkyu, Deputy Director of the Integrated Circuits and Systems Laboratory at IME, commented, “The breakthrough is made possible using an innovative multi-supply-voltage scheme and dynamic-range folding approach in the circuit architecture to achieve low-voltage, low power consumption without trading off high performance data acquisition.”

“To realise a fully implantable neural recording system, we are also working with other departments on the neural probe design and materials, as well as the incorporation of drug delivery capability.”

5. Professor Dim-Lee Kwong, Executive Director of IME, said, “The outcome of the partnership presents tremendous potential to advance neuroscience research and to restore functions of brain-injured patients. We expect IME’s expertise in circuit design, sensor research, advanced packaging, and deep capabilities in fabrication know-how to contribute strongly in this application space.”
6. Assistant Professor Yuanjin Zheng, Programme Director, VIRTUS IC Design Center of Excellence at NTU, said, “Being able to develop a power efficient chip which can record multi-channel neural signals simultaneously is a testament to NTU’s deep expertise and vast experience in designing integrated circuits. NTU is also well-known for engaging in interdisciplinary research especially in the areas of Innovation and Future Healthcare, which we leveraged upon to help bridge the gap between neural science research and clinical applications.”
7. Associate Professor Gavin Dawe from Department of Pharmacology, Yong Loo Lin School of Medicine, National University of Singapore and Singapore Institute for Neurotechnology (SINAPSE), said “As experts in neurophysiology our group at NUS worked closely with the rest of the team from IME and NTU to complete preclinical tests on the performance of the device recording neuronal activity in living brain tissue. This power-efficient yet high performance device for recording neural signals will enable new possibilities for development of implantable brain interfaces allowing paralyzed patients to control wheel chairs or robotic arms with their minds.”

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About Institute of Microelectronics (IME)

The Institute of Microelectronics (IME) is a research institute of the Science and Engineering Research Council of the Agency for Science, Technology and Research (A*STAR). Positioned to bridge the R&D between academia and industry, IME's mission is to add value to Singapore's semiconductor industry by developing strategic competencies, innovative technologies and intellectual property; enabling enterprises to be technologically competitive; and cultivating a technology talent pool to inject new knowledge to the industry. Its key research areas are in integrated circuits design, advanced packaging, bioelectronics and medical devices, MEMS, nanoelectronics, and photonics. For more information about IME, please visit <http://www.ime.a-star.edu.sg>.

About Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is the lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based and innovation-driven Singapore. A*STAR oversees 14 biomedical sciences, and physical

sciences and engineering research institutes, and seven consortia & centre, which are located in Biopolis and Fusionopolis, as well as their immediate vicinity. A*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, hospitals, research centres, and with other local and international partners. Please visit www.a-star.edu.sg

About Nanyang Technological University

A research-intensive public university, Nanyang Technological University (NTU) has 33,500 undergraduate and postgraduate students in the colleges of Engineering, Business, Science, Humanities, Arts, & Social Sciences, and its Interdisciplinary Graduate School. It has a new medical school, the Lee Kong Chian School of Medicine, set up jointly with Imperial College London.

NTU is also home to world-class autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre on Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI), Energy Research Institute @ NTU (ERI@N) and the Institute on Asian Consumer Insight (ACI).

A fast-growing university with an international outlook, NTU is putting its global stamp on Five Peaks of Excellence: Sustainable Earth, Future Healthcare, New Media, New Silk Road, and Innovation Asia.

Besides the main Yunnan Garden campus, NTU also has a satellite campus in Singapore's science and tech hub, one-north, and a third campus in Novena, Singapore's medical district.

About the NUS Yong Loo Lin School of Medicine (YLLSoM)

Established in 1905, the NUS Yong Loo Lin School of Medicine was the first institution of higher learning in Singapore and the genesis of what would become the National University of Singapore. The School offers one of the finest undergraduate medical programs in the Asia Pacific region and commands international recognition and respect. The latest university rankings from Quacquarelli Symonds (QS) have again rated the School as Asia's best for the third consecutive year. Globally, it is now ranked 20th, up one spot from its 2012 ranking.

The School admits 300 students to its medical undergraduate degree programme annually. It strives to fulfill its tripartite mission of providing excellent clinical care, training the next generation of healthcare professionals, and fostering research that will

transform the practice of medicine. It plays a pivotal role in producing future leaders in healthcare delivery, discovery and public service as well as in Singapore's Biomedical Sciences Initiative and Singapore Medicine, an initiative to further develop as a regional medical center.

The School's 16 departments in the basic sciences and clinical specialties work closely with the Alice Lee Centre for Nursing Studies and the Centre for Biomedical Ethics to ensure that teaching and research are aligned and relevant to Singapore's healthcare needs.

For more information about the Yong Loo Lin School of Medicine, please visit <http://medicine.nus.edu.sg/corporate>