

PRESIDENT'S SCIENCE AWARD 2021

Professor Chen Xiaodong

President's Chair Professor, School of Materials Science and Engineering, Nanyang Technological University (NTU)
Director, Innovative Centre for Flexible Devices, NTU
Scientific Director, Institute of Materials Research and Engineering, Agency for Science, Technology and Research (A*STAR)
Deputy Director, Singapore Hybrid-Integrated Next-Generation μ -Electronics Centre (SHINE)

“For his outstanding contribution to advanced materials research for soft bioelectronics capable of digitising biological senses and extending human sensing capabilities, and their application to advanced manufacturing and healthcare wearables”

Over the last 12 years, Professor Chen Xiaodong's cutting-edge interdisciplinary research has advanced the frontiers of materials science and flexible electronics, and created the potential to disrupt advanced manufacturing, smart wearables, and digital healthcare.

There is ever-rising demand for more seamless human-electronic device integration that will enable consistent data capture and application. However, the major challenge lies in the inability of conventional electronics to pick up reliable biological signals from the human body. This is due to fundamental mismatches such as incompatible surfaces (soft skin vs rigid sensors) and signal reading formats (physical vs digital systems). Determined to overcome these obstacles, Prof Chen directed his research focus on soft bioelectronics to develop solutions that could bridge the space between humans and technology.

Prof Chen has created a wide range of soft composite materials for flexible electrodes which have superior stretchability and electronic conductivity. These electrodes can conform and adhere to human skin and animal tissues and are also easily scalable. Through these efforts, he pioneered an emerging field called mechanomaterials, by establishing a method that proactively programs the functionalities of materials by leveraging the force-geometry-property relationships.

A crucial requirement to advance the application of science and technology in augmenting human performance, is the digitalisation of human senses. Prof Chen has resolved challenges of fidelity, stability, sensitivity, and reliability for biological sensing, using advanced functional materials to build bioelectronic interfaces that can convert biological signals into electrical outputs. Among his latest successes is the creation of the world's first plant-based robot, which he developed using a soft composite material to pick up electrical signals in plants. This breakthrough research has the potential to enhance the monitoring of the health of crops, and food security.

Prof Chen augmented the sensing capability of soft sensors by mimicking the human nervous system. He raised the accuracy of hand gesture recognition technology to 100% by fusing visual and tactile sensors. Prof Chen also developed an artificial neural network for use in electronic noses, which can assess the freshness of meat at up to 98.5% accuracy, greatly enhancing food safety. As illustrated in his research achievements, the digitalisation of the human senses has great potential to become a technology enabler for the next-generation soft robotics, contributing to improvements in prostheses, wearables for healthcare, and other smart applications.

Prof Chen is a firm believer in fundamental research to benefit humanity. To achieve this, he partners with the private sector and government agencies to accelerate the deployment of his technology. For example, his inventions, such as artificial epidermis based on plasticized silk and wearable tactile sensors, are undergoing validation tests for skincare product development. The stretchable electrodes for the monitoring of long-term chronic conditions have also been licensed to companies for commercialization.

Prof Chen has forged strong partnerships with local and international scientists and helped elevate Singapore's standing on the global R&D stage. As the Programme Director of the Advanced Manufacturing and Engineering Programme on Cyber-Physiochemical Interfaces and the Deputy Director of SHINE, Prof Chen helps steer national efforts to build platforms for the manufacturing of next-generation flexible electronic devices and to develop technologies capable of perceiving and analysing human physiological wellbeing.

As a President's Chair Professor of Materials Science and Engineering at NTU and the Scientific Director of A*STAR's IMRE, Prof Chen's role has extended beyond the pursuit of science. He is a passionate advocate for the nurturing of talent and leaders who work to solve societal challenges and shape the future of Singapore.

Prof Chen has published over 330 papers that are globally recognized and highly cited, garnering more than 30,000 citations to date. Professor Chen has received numerous accolades for his outstanding scientific contributions, including the Singapore National Research Foundation (NRF) Investigatorship, Singapore NRF Fellowship, Winner of Falling Walls, and Friedrich Wilhelm Bessel Research Award.