Nongjian Tao (1963–2020)

Professor Nongjian 'NJ' Tao, a paragon of nanoscience, was lost to our community at the early age of 56. A true polymath, with interests in physics, chemistry, biology, engineering and business, his wide-reaching interests and expertise allowed him to make great advances in nanoscale measurements in a wide range of areas including molecular electronics, optical imaging and biosensing. He is most well-known for the development of techniques for electrically contacting and interrogating molecular electronic devices. But, he will be remembered by his family, friends, colleagues, students and postdocs for his kind personality, gentle spirit, unassuming demeanour, passion for science and intellectual brilliance.

In 2003 NJ devised a method for creating molecular electronic devices by using a scanning tunnelling microscope (STM) as a type of probe station for molecules, a technique that would eventually become known as the STM break junction. This technique has become one of the primary methods for reliably making contact to a single molecule, and is now used worldwide for investigating the electronic properties of molecular devices. One of the key components to the success of this technique is the ability to collect large enough datasets for statistical analysis, and this allowed for far more robust values for molecular conductance measurements than most low-throughput approaches at the time. As a result, groups around the world began making careful comparisons between the same molecules and to design new molecules with specific electronic and transport properties.

With a formal training in physics, NJ was an intrepid inventor. In addition to the STM break-junction system, he developed new techniques for using surface plasmon resonance (SPR) to image electrochemical activity on electrode surfaces, optical and mechanical systems for metabolic and chemical sensing, diagnostic, and imaging applications. These activities also resulted in the co-founding of two successful and active start-ups: Biosensing Instruments, which leverages his advances in optics and imaging and Breezing, which focuses on on-demand, mobile metabolism monitoring.

NJ was born in 1963 in Anhui Province, China, and came to the US in 1984 to study for a PhD in physics at Arizona State University (ASU). He was among the tiny number of elite physics students chosen to attend a US university under the China-US Physics Examination and Application (CUSPEA) program, started by Chinese American Nobel Laureate Tsung-Dao Lee as one of the first openings between the two countries. As a graduate student in the lab of Stuart Lindsay, he made several key discoveries while investigating the physics of DNA molecules, publishing 12 papers on the subject during his PhD studies. After postdoctoral research at City College, New York, he returned to ASU, working in the very new area of nanoscience. In 1992, he was recruited to a faculty position at Florida International University (FIU). In 1996, while at FIU, he published a landmark experiment in molecular electronics, at a time when he had no graduate students or other help in the lab.

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He was recruited as a full professor in electrical engineering by ASU in 2001, and shortly after produced the first paper on the STM break junction with a graduate student, Bingqian Xu, as a co-author. This represented an inflection point in his career. His lab quickly grew in the intervening years, and went from a group of around 7 in 2003 to more than 50 once he became the Director of the Center for Bioelectronics and Biosensors in the Biodesign Institute in 2008, a position he held until his death. During this time, he maintained three major research thrusts, sensing, optical devices and molecular electronics. Each area grew in breadth and depth, and the combination of these programmes allowed him to look at the big picture behind his research and to search for interactions between the thrusts and collaborations with other research groups. This approach allowed him to apply fundamental details he had learned about charge transport to other areas, such as the electrochemical imaging system, and concepts in sensing and mechanical control to the improvement of measuring systems for molecular electronic devices.

During this time he began mentoring a larger number of students than ever, and he hired former students and postdocs as research faculty, helping to launch an ever-increasing number of academic and industrial careers. His mentoring style was much like his scientific approach. He led by example, working long hours, thinking deeply about the research and constantly asking questions to challenge both himself and his students. With the notoriety and accolades that followed him throughout his illustrious career NJ never developed a sense of hubris; instead, he maintained his terrific work ethic, open-door policy with his team and understated sense of humour. He aimed to teach his students to be as passionate about science as he was, to explore and try new things whenever possible. When he floated a new idea in the lab his motto was always to try it. He would state that we could all think of thousands of reasons that an idea wouldn't work, but we wouldn't know whether any of them were correct if we didn't try. This approach led to a unique sense of community within the lab, and the group became like an extended family for many of the team members.

He also approached his mentoring activity with an astounding sense of grace, he never angered. When equipment broke down he would quip that "If nothing broke, I'd think you weren't doing anything." To him the worst sins in science were to not think rationally, and to not work actively. And he did both with an unparalleled passion and purpose. He will be sorely missed by all who knew him. ❐

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Published online: 27 April 2020
https://doi.org/10.1038/s41565-020-0686-5