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Introduction to the soft wearable sensors themed collection

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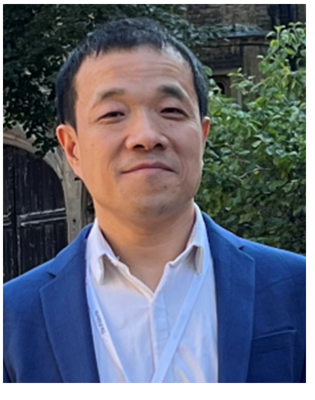
Soft wearable sensors offer promising potential for advanced diagnostics, therapeutics, and human–machine interfaces. Unlike conventional devices that are bulky and rigid, often compromising skin integrity, comfort, and user compliance, soft wearable sensors are flexible, conformable, and better suited to the dynamic skin surface. This improved mechanical integration enhances signal fidelity and device performance, while also enabling safer, more comfortable, and continuous physiological monitoring in real-world environments. Driven by advances in materials science and engineering, soft wearable sensors are overcoming the mechanical limitations of traditional bioelectronics, paving the way for personalized healthcare and next-generation robotics.

This themed collection highlights current advances in soft wearable sensors, from the discovery of novel materials to breakthroughs in fabrication techniques, and explores their promises, challenges, and potential pathways from next-generation medical diagnostics and therapeutics to human–machine interfaces and robotics. Among these material innovations, comprehensive reviews by the Han group (**https://doi.org/10.1039/D5MH00563A**) and the Zhang group (**https://doi.org/10.1039/D5MH00453E**) underscore the pivotal role of shape-morphing materials, those that change shape in response to external stimuli, in enabling wearable actuators, haptic feedback systems, and emerging diagnostic technologies such as wearable ultrasound imaging patches. Kim and Ko's group further addressed challenges in ionic transport kinetics and sensitivity of piezoionic tactile sensors, where mechanical stimuli induce ion movement and generate electrical signals, by introducing a biomimetic design inspired by voltage-gated ion channels in eukaryotic cells (**https://doi.org/10.1039/D5MH00503E**). Their ionic composite structure reduces electrostatic attraction between ion pairs, facilitating rapid ion movement and accumulation, ultimately enhancing the output signal.

Fabrication techniques that enable the scalable, cost-effective production of soft wearable sensors are key to the societal integration of soft wearable sensors. In this themed collection, the Cheng group reviewed the use of wet chemistry fabrication methods, such as electrospinning and inkjet printing, for the production of stretchable conductors, focusing on conductive composite materials that embed conductive nanomaterials within an elastomeric matrix (**https://doi.org/10.1039/D5NH00048C**). The Someya group further showed how such techniques can be used to address the mechanical mismatch between soft skin electrodes and rigid, thick interconnects by creating a smooth thickness gradient through successive electrospinning of nanofiber layers, guided by controlled spinneret motion (**https://doi.org/10.1039/D5MH00181A**). This smooth thickness transition eliminated sharp interfaces, enhancing mechanical durability and ensuring stable electrical



Wenlong Cheng

Dr Wenlong Cheng is a professor in the School of Biomedical Engineering at the University of Sydney. He was a director of research in the Department of Chemical and Biological Engineering at Monash University, Australia. He is currently NHMRC Investigator Leadership Fellow and a Fellow of the Royal Society of Chemistry and was an Ambassador Tech Fellow in the Melbourne Centre for Nanofabrication. He earned his PhD from the Chinese Academy of Sciences in 2005 and his BS from Jilin University, China in 1999. He was an Alexander von Humboldt Fellow in the Max Planck Institute of Microstructure Physics and a research associate in the Department of Biological and Environmental Engineering of Cornell University. His recent research interests include biosensors, flexible plasmonic nanomaterials and soft wearable electronics.

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performance under repeated strain. Finally, the Bai group demonstrated the fabrication of recyclable, environmentally sustainable, and mechanically flexible conductive fibers by incorporating MXene nanosheets into a gelatin matrix *via* wet spinning (**https://doi.org/10.1039/D5MH00831J**). These thermoreversible fibers maintained consistent mechanical and electrical properties after a recycling cycle using mild heat.

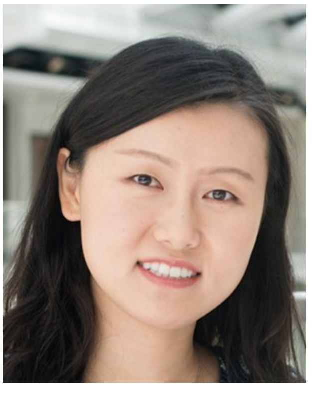
Soft wearable sensors enable continuous, real-time health monitoring, and hold promise for advancing personalized healthcare. This themed collection highlights their applications in the early detection of neurological disorders through sleep and motion monitoring (**https://doi.org/10.1039/D5MH00528K**), in respiratory health *via* integration into smart masks (**https://doi.org/10.1039/D5MH00279F**), and in the management of chronic conditions through biointerface engineering (*e.g.*, smart textiles, biosymbiotics, and elastic bands) (**https://doi.org/10.1039/D5MH00758E**). Beyond health monitoring, their potential in human–machine interfaces is also explored. A comprehensive review by the Li group showcases their use in augmented and virtual reality, with a focus on sensors and actuators designed to enhance the eating experience (**https://doi.org/10.1039/D5MH00488H**).

These examples represent just a glimpse of the many exciting contributions to this themed collection on soft wearable sensors, published in *Materials Horizons* and *Nanoscale Horizons*. We invite you to explore this themed collection.

Finally, we extend our sincere thanks to all contributing authors and reviewers, as well as the editorial staff at the Royal Society of Chemistry. This collection would not have been possible without their invaluable support.

Dae-Hyeong Kim

Dr Dae-Hyeong Kim obtained his BS and MS degrees in chemical engineering from Seoul National University (SNU), Korea, in 2000 and 2002, respectively. He received his PhD in materials science and engineering from the University of Illinois at Urbana Champaign (UIUC) in 2009. From 2009 to 2011, he was a post-doctoral research associate at UIUC. He joined SNU in 2011 and is currently a professor in the School of Chemical and Biological Engineering of SNU. He has been serving as an associate director at the Center for Nanoparticle Research at the Institute for Basic Science (IBS) from 2017. He has been focusing on the research of nanomaterials-based bioelectronics.



Nanshu Lu

Dr Nanshu Lu is a professor and the Carol Cockrell Curran Chair in Engineering at the University of Texas at Austin. She earned her Bachelor's degree from Tsinghua and PhD from Harvard and was a Beckman Postdoc at UIUC. Her research focuses on soft electronics for human and robotic integration. She is a Clarivate Highly Cited Researcher, ASME and AIMBE Fellow, and serves on SES and ASME committees. Honors include NSF CAREER, ONR and AFOSR YIP, ASME Hughes Award, MIT TR35, iCANX/ACS Nano Rising Star, and recognition as a world-changing woman at UT Austin.

John Rogers

Dr John A. Rogers is a professor at Northwestern University (NU). He obtained his BA and BS degrees in chemistry and in physics from the University of Texas, Austin, in 1989. From MIT, he received SM degrees in physics and in chemistry in 1992 and a PhD in physical chemistry in 1995. From 1995 to 1997, Rogers was a Junior Fellow in the Harvard University Society of Fellows. Prior to NU, he spent time at Bell Labs and at the University of Illinois. Rogers works on various topics in the field of bioelectronics.

Alina Rwei

Dr Alina Rwei is an assistant professor at Delft University of Technology (TU Delft). She earned both her undergraduate and PhD degrees from the Massachusetts Institute of Technology (MIT). She completed her postdoctoral training at Northwestern University as an NIH TL1 fellow. A chemical engineer and materials scientist by training, Rwei works on smart diagnostic and therapeutic systems, specializing in advanced drug delivery platforms and real-time, continuous biosensors.