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Flexible sensors and actuators by metal nanowire percolation networks

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It is well expected that the future electronics will be in the form of wearable electronics. Google's smart glass and Apple's iWatch are the first generations of wearable electronics. However, they are still mainly composed of rigid electronics even though human body is soft and elastic. To realize more meaningful and practical wearable electronics, electronic components should be stretchable or at least flexible. We have developed various hierarchical multi-scale hybrid nanocomposites for highly stretchable, highly flexible or highly transparent conductors ultimately applied for wearable electronics applications. The hybrid nanocomposite combine the enhanced mechanical compliance, electrical conductivity and optical transparency of small CNTs (d~1.2 nm) and the enhanced electrical conductivity of relatively bigger AgNW (d~150 nm) backbone to provide efficient multi-scale electron transport path with AgNW current backbone collector and local CNT percolation network. Additionally, this approach combines materials that stretch and structure that stretch strategies to demonstrate highly stretchable conductor. As a feasibility test of our hierarchical multi-scale hybrid nanocomposite stretchable and transparent conductor research, we have demonstrated a highly stretchable LED circuit and a touch panel. This is just a very tiny fraction of application area of our works. We expect our approach can be applied to huge range of wearable electronics elements such as high performance displays, solar cells, sensors, touch screens in flexible and stretchable forms and ultimately to all future electronics. Therefore, this research results have a great ripple effect on various future electronics development and will be sustainably studied. Considering the huge impact, originality and advantages of our research results, this paper provides basic research results and becomes a classical reference for future wearable electronics field.

Recent Publications

1. J H Park, S Han, D Kim, B K You, S Hong, J Seo, J Kwon, C K Jeong, H J Park, T S Kim, S H Ko and K J Lee (2017) Plasmonic-tuned flash cu nano-welding for ultrafast photochemical-reducing and interlocking on flexible plastics. *Advanced Functional Materials*; 27(29): 1701138.
2. K K Kim, S Hong, H M Cho, J Lee, Y D Suh, J Ham and S H Ko (2015) Highly sensitive and stretchable multi-dimensional strain sensor with prestrained anisotropic metal nano-wire percolation networks. *Nano Letters;* 15(8): 5240-5247.

Biography

Seung Hwan Ko is a Professor in Applied Nano and Thermal Science Lab, Mechanical Engineering Department, Seoul National University, Republic of Korea. Before joining Seoul National University, he was a Faculty at Graduate School of EEWS (Energy, Environment, Water and Sustainability), KI Nano-century and Department of Mechanical Engineering at KAIST (Korea Advanced Institute of Science and Technology), Republic of Korea. He has completed his PhD degree in Mechanical Engineering from University of California, Berkeley in 2006. He has worked as a Researcher at Lawrence Berkeley National Lab until 2009. His research interest is laser assisted nano/micro-fabrication process development, laser nano-material interaction, low temperature process development for flexible, stretchable and wearable electronics and crack assisted nano-manufacturing.

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