Stretchable devices for wearable electronics applications

Dae-Hyeong Kim [1]
[1]Center for Nanoparticle Research, Institute for Basic Science,
School of Chemical and Biological Engineering,
Seoul National University, Seoul 151-744, Korea
Tel.:82-2-880-1565, E-mail: dkim98@snu.ac.kr

Recent advances in prosthetic [1], implantable, and wearable [2] devices comprising microelectronics and nanomaterials have attracted great attention from researchers involved with biomedical application. However, conventional devices integrated on inherently rigid substrate prevent from solving unique integration challenges for implantable devices and prosthetic skin. Here, we describe novel materials and design strategies for constructing multifunctional prosthetic skin (Fig. 1) and bioresorbable stent which incorporate variety of flexible/stretchable sensors and actuators for their unique functionalities. The multifunctional prosthetic skin is instrumented with ultrathin, single crystalline silicon nanoribbon strain, pressure, and temperature sensor arrays as well as associated humidity sensors, electroresistive heaters, and stretchable multi-electrode arrays (MEA) for nerve stimulation. The bioresorbable stent comprises drug-infused functionalized nanoparticles to enable flow sensing, temperature monitoring, data storage, inflammation suppression, localized drug delivery, and hyperthermia therapy. Quantitative analyses of sensing and actuating performances of these systems under various conditions verify the individual components and in vivo experiments of both systems demonstrate the validity of their system-level functions. These systems combine the cutting edge of flexible, stretchable and transient electronics to provide new opportunities and insights in biointegrated electronic devices.

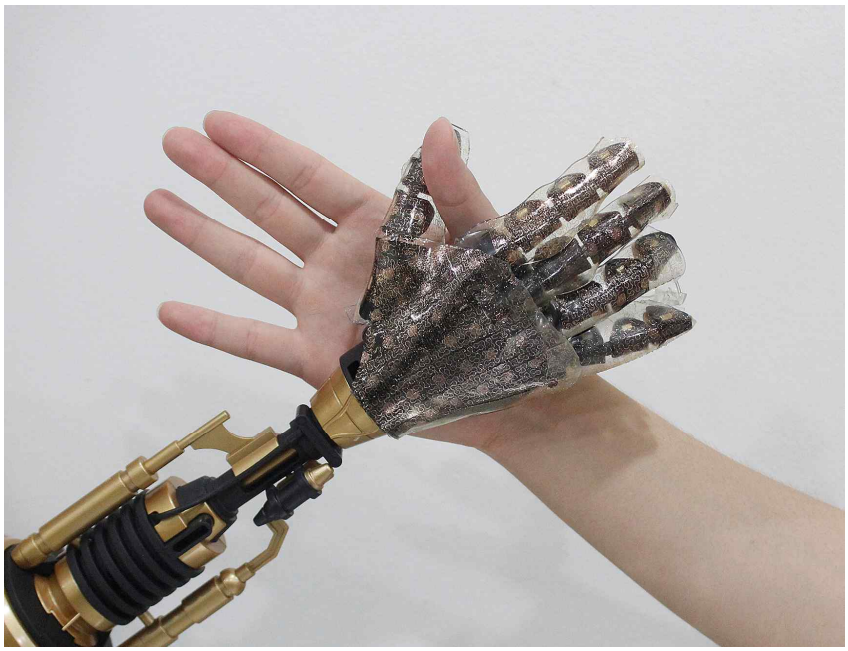

Fig. 1. Image of Prosthetic Skin

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References

1. J. Kim et al., *Nat. Comm.* 5, 5747 (2014).
2. D. Son et al. *Nat. Nanotechnol.*, 9, 397 (2014).