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# Skin inspired electronic skins for wearable healthcare devices

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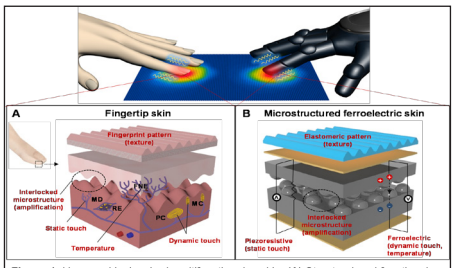


**Figure 1**. Human skin–inspired multifunctional e-skin. (A) Structural and functional characteristics of human fingertips. (B) Flexible and multimodal ferroelectric e-skin.

Flexible physical sensors with high sensitivities have gained great attentions in the fields of wearable devices, robotic skins and biomedical diagnostics. In human fingertip skins, fingerprint patterns and interlocked epidermal-dermal micro-ridges have critical roles in amplifying and transferring tactile signals to various mechanoreceptors, enabling spatio-temporal perception of various static and dynamic tactile signals. Here, mimicking the structures and functions of fingertip skin, we introduce highly-sensitive, multifunctional and stretchable electronic skins. Inspired by the interlocked microstructures found in epidermal-dermal ridges in human skin, piezoresistive interlocked micro-domes are employed for the demonstration of stress-direction-sensitive, stretchable electronic skins. We show that interlocked micro-dome arrays possess highly direction-sensitive detection capability of various mechanical stimuli including normal, shear, stretching, bending and twisting forces. We also demonstrate that ferroelectric skins with fingerprint-like patterns and interlocked microstructures can detect and discriminate multiple spatio-temporal tactile stimuli including static and dynamic pressure, vibration and temperature with high sensitivities. For applications, we demonstrate that stretchable electronic skins attached on the human skin can be used as wearable healthcare monitoring devices, which are able to distinguish various mechanical stimuli applied in different directions, selectively monitor different intensities and directions of air flows and vibrations, and sensitively monitor human breathing flows and voice vibrations. In addition, dynamic touch sensing ability is employed for the precise detection of acoustic sounds, and discrimination of various surface textures. Finally, for multifunctional wearable and skin-attachable devices, we show smart adhesive pads with temperature-responsive adhesion properties and force-dependent color changing touch screens based on mechanochromic surface coatings.

## Recent Publications

1. Y Lee and H Ko et al. (2018) Flexible Ferroelectric Sensors with Ultrahigh Pressure Sensitivity and Linear Response over Exceptionally Broad Pressure Range. *ACS Nano;* 12: 4045.
2. M Ha and H Ko et al. (2018) Skin-Inspired Hierarchical Polymer Architectures with Gradient Stiffness for Spacer-Free, Ultrathin and Highly-Sensitive Triboelectric Sensors. *ACS Nano*; 12: 3964.

## Biography

Hyunhyub Ko is currently an Associate Professor in Energy and Chemical Engineering at Ulsan National Institute of Science and Technology. He has received his PhD in Materials Science and Engineering from Georgia Institute of Technology in 2008, MS in Materials Science and Engineering from Iowa State University in 2004, MS in Chemical Engineering from Yonsei University in 2001 and BS in Chemical Engineering from Chung-Ang University in 1999. From 2008 to 2010, he worked at University of California, Berkeley as a Postdoctoral Fellow in the Department of Electrical Engineering and Computer Sciences. His research interests are in the area of functional nano-materials for flexible electronics, sensors and energy devices.

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