Skin-Like Capacitive Tactile Sensor Based on Styrene-Ethylene-Butylene-Styrene Elastomer for Human Activity Detecting

Gen-Wen Hsieh
Institute of Lighting and Energy Photonics, College of Photonics, National Yang Ming Chiao Tung University, Taiwan

Ping-Sheng Huang
Institute of Lighting and Energy Photonics, College of Photonics, National Yang Ming Chiao Tung University, Taiwan

Abstract

With accelerating global ageing, more and more individuals living with age-related health issues are in great need of health monitoring and daily activity detection. To address this need, a sensor with high sensitivity, low limit of detection, and long-term stability, which can also operate across a broad pressure regime and convey data remotely, are highly desired. Among different sensing mechanisms, capacitive-based tactile sensors play a dominant role owing to the advantages of simple infrastructure, rapid response, low power consumption, long durability, and scalable, low-cost fabrication. The choice of elastomeric dielectric materials is very crucial to the desired sensing range and capability. Here, we present a wearable capacitive tactile sensor by sandwiching a styrene-ethylene-butylene-styrene (SEBS)-elastomer between copper foil electrodes with SEBS substrates for human activity monitoring. We tailored and evaluated four types of SEBS dielectric films, including flat, porous, surface microstructured, and a hybrid of porous and surface microstructured, using a cost-effective and simple fabrication method. The porous SEBS was fabricated by emulsifying SEBS with a household laundry detergent, while the microstructured SEBS was formed using a reusable stainless steel frame as the template. Specifically, the resulting SEBS-based tactile sensor featuring air pores and microstructures can manifest subtle-to-gentle pressure sensing, high sensitivity of up to 1.42 kPa⁻1, ultralow limit of detection of 1.2 Pa, fast response time, and excellent reliability and stability, which can monitor a variety of human activities and physiological signals, such as air blowing, neck bending, object grasping, and radial artery pulse.

Keywords

Capacitive pressure sensor; styrene-ethylene-butylene-styrene; wearable electronics.