Soft Wearable Microfluidic Sensors for Healthcare Applications

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Abstract

The future of healthcare wearables lies in continual sensing in an unobtrusive manner. Tactile sensing is especially important to capture mechanotransduced signals arising from the body, or as a result of interactions with the external environment. However, conventional sensors are rigid, stiff and obstrusive. Therefore, one of the key objectives is to confer flexibility and stretchability to our sensing elements, while maintaining its sensitivity and robustness. Here, we develop a novel liquid-based microfluidic and microtubular sensors that possess high flexibility, durability, and sensitivity. The sensors comprise a soft elastomer-based microfluidic template encapsulating a conductive liquid which serves as the active sensing element of the device. This sensor is capable of distinguishing and quantifying the various user-applied mechanical forces it is subjected to. We demonstrated healthcare applications of our sensors in rehabilitation monitoring, artificial sensing and disease tracking such as that for diabetic patients. Overall, our work highlights the potential of the liquid-based microfluidic sensing platforms in a wide range of healthcare applications and further facilitates the exploration and realization of functional liquid-state device technology.

References

[1] Xi, W., Kong, F., Yeo, J. C., Yu, L. T., Sonam, S., Dao, M., Gong, X. B., Lim, C. T.: Soft tubular microfluidics for 2D and 3D applications. Proceedings of the National Academy of Sciences of the United States of America, Vol. 114, No. 40, pp. 10590-10595, 2017.

[2] Xi, W., Yeo, J. C., Yu, L., Zhang, S., Lim, C. T.: Ultrathin and Wearable Microtubular Epidermal Sensor for Real‐Time Physiological Pulse Monitoring. Advanced Materials Technologies, Vol. 2, No. 5, pp. 1700016, 2017.

[3] Yeo, J. C., Liu, Z., Zhang, Z. Q., Zhang, P., Wang, Z. P., Lim, C. T.: Wearable mechanotransduced tactile sensor for artificial haptic perception, Advanced Materials Technologies, Vol. 2, No. 6, pp. 1700006, 2017.

[4] Yeo, J. C., Yap, H. K., Wang, X., Wang, Z., Yeow, C. H., Lim, C. T.: Flexible and stretchable strain sensing actuator for wearable soft robotics application. Advanced Materials Technologies, Vol. 1, No. 3, pp. 1600018, 2016.

[5] Yeo J. C., Kenry, Yu, J., Loh, K. P., Wang, Z., Lim, C. T.: Triple-State Liquid-Based Microfluidic Tactile Sensor with High Flexibility, Durability, and Sensitivity. ACS Sensors, Vol. 1, No. 5, pp. 543-551, 2016.