微阵列结构柔性压力传感器研究进展 *

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摘　要：柔性压力传感器因形状易控、体积小、机械性能好等优点，成为柔性电子器件领域的研究热点之一。传统工作原理下，除先进功能材料外，微阵列结构的引入对进一步提升器件灵敏度、响应时间等综合性能具有重要意义。本文从材料选择、微阵列分布方式、构造方法及传感特性等方面对微阵列结构柔性压力传感器的研究进展进行了综述。首先，归纳了微阵列构造常用材料；其次，对比了基于不同分布方式的微阵列结构；随后，总结了微阵列结构的制备工艺；最后，重点讨论了几种常见微阵列柔性压力传感器的传感特性机理。未来应进一步从传感器力－电转换机制、多元环境下器件工作稳定性等方面进行深入探究，以期为开发超高性能柔性传感器件提供理论基础。

关 键 词：柔性电子；柔性压力传感器；微阵列结构；传感特性

中图分类号：TB43；TN305.8　　**文献标识码**：A　　**文章编号**：1002－0322（2023）05－0013－16

doi：10.13385/j.cnki.vacuum.2023.05.02

Progress on Microarray-structured Flexible Pressure Sensors

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Abstract: Recently, microarray-structured flexible pressure sensors have attracted extensive attention owing to their controllable shape, small size and high mechanical properties. In addition to the selection of advanced functional materials, the introduction of microarray structures for flexible pressure sensors under traditional working principles is important to further enhance the sensing performance of the device in terms of sensitivity and response time. In this paper, the materials, distribution of microarray, fabrication strategies and sensing characteristics are systematically reviewed. Firstly, the common materials used to fabricate microarray-structured flexible pressure sensors are summarized. Secondly, the different distribution types of the microarray structure are compared. The fabrication strategies are then compared and summarized in detail. Finally, the mechanisms of sensing characteristics of several common-used microarray-structured flexible pressure sensors are mainly discussed. In the future, the force-electric conversion mechanism of the sensor and the stability of the device under multiple environments should be further investigated in order to provide a theoretical basis for the development of flexible pressure sensors with ultra-high sensing performance.

Key words: flexible electronics; flexible pressure sensor; microarray structure; sensing characteristics

随可穿戴电子时代来临，柔性压力传感器因制备简单、材料丰富、机械性能好及灵敏度高等优点，被广泛应用于触摸显示[1]、软体机器人[2]、电子皮肤[3-5]及军事医疗[6]等领域。目前，柔性压力传感器的相关研究主要集中于固定工作原理下新型微纳结构制备及先进功能材料的选择方面，旨在提高灵敏度、动态范围、响应/迟滞时间、循环稳定性及检测极限等关键性能参数。微纳结构的引入可以产生更多的接触应力与应变集中，从而大幅度提升器件综合性能[7]。

柔性压力传感器新型微纳结构大致可分为三维立体型（海绵[8]、多孔聚合物[9]等），二维平面

收稿日期：2022－06－01

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* **基金项目**：国家自然科学基金（51773030）。