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FLEXIBLE SENSING TECHNOLOGY AND ITS APPLICATION IN HUMAN-MACHINE INTERACTION

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Absrtact. Piezoelectrets are a type of artificial micro-structured functional material with strong piezoelectric activities. They are usually based on space-charge polymer electrets and possess advantages such as softness, low impedance, low cost, etc. Different flexible pressure/vibration sensors were developed based on piezoelectrets, and a variety of applications on human physiological signal monitoring were carried out, providing a support for the development of flexible electronic technology.

Keywords: piezoelectrics, sensors, polymer electrets.

Introduction

Compared with traditional sensing technologies, flexible sensing is more capable of achieving wearable/portable and real-time monitoring of human physiological signals, and has great application prospects in the field of life and health. Among various flexible sensors, piezoelectrets have received extensive attention from the academic and industrial communities due to their simple structure, high sensitivity, and good stability. Piezoelectrets are usually based on space-charge polymer electrets and to a certain extent, they combine the advantages of traditional piezoelectric ceramics and piezoelectric polymers (such as PVDF and its copolymers), making them ideal candidates for wearable/portable sensing applications.

Materials and Methods

The porous structure is one of the key factors determining the performance of piezoelectrets. Generally, piezoelectrets can be classified into two types: foam-structure and layer-structure piezoelectrets. Cellular polypropylene (PP) is a representative example of foam-structure piezoelectrets, which has been widely studied and achieved various applications; however, the foam structures prepared by the gas diffusion-expansion (GDE) process are often uncontrollable with large void size distribution, and thus the large-scale production and application of foam-structure piezoelectrets are often limited. Combination of solid fluoropolymer (such as polytetrafluoroethylene, PTFE, and fluorinated ethylene propylene, FEP, etc.) films and gas layers can form layer-structure piezoelectrets, with regular voids ensuring high consistency in applications; however, the layer structures may also have some drawbacks such as complex preparation process and low structural strength, which sometimes hinder applications. Besides, compound-structure piezoelectrets are proposed, through optimizing the structure design and preparation to enhance the performance of piezoelectrets.

Research and Discussion

Based on the foam- [1], layer- [2], and compound-structure [3] piezoelectrets prepared in our lab, several types of flexible pressure/vibration sensors have been developed and diversified applications for monitoring human physiological signals have been carried out, including the real-time acquisition of multimodal information such as pulse, heartbeat, breathing, swallowing, walking, sleep, and posture.

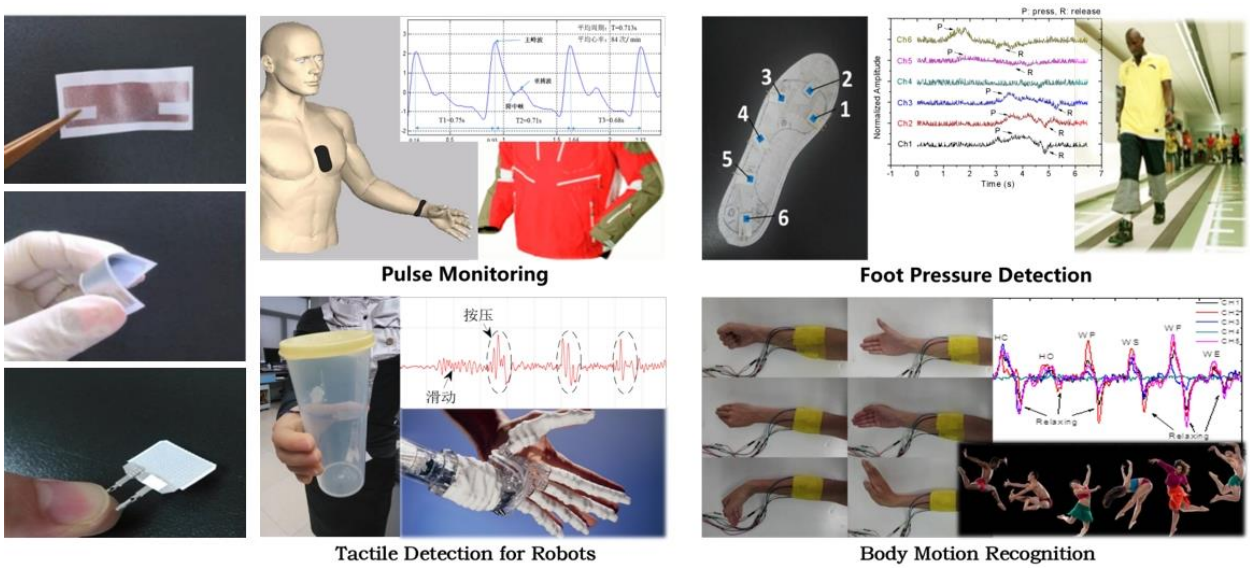

Fig. 1. Application of polymer piezoelectrets.

Conclusion

Flexible sensors are gaining increasing attentions from both research and industrial fields. The soft, lightweight, wearable, and/or portable characteristics make them quite suitable for real-time monitoring of physiological signals. The space-charge piezoelectrets exhibit outstanding performances on both material and sensing aspects, which provides an ideal candidate for force/pressure/vibration detection in various disciplines. More fantastic applications are expected in future.

Thanks

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ГИБКИЕ ТЕХНОЛОГИИ СЕНСОРОВ И ИХ ПРИМЕНЕНИЕ ВО ВЗАИМОДЕЙСТВИИ ЧЕЛОВЕКА И МАШИНЫ

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Аннотация. Пьезоэлектреты — это тип искусственного микроструктурированного функционального материала с высокой пьезоэлектрической активностью. Обычно они основаны на полимерных электретах с объемным зарядом и обладают такими преимуществами, как мягкость, низкое сопротивление, низкая стоимость и т. д. Разработаны различные гибкие датчики давления/вибрации на основе пьезоэлектретов, и были проведены различные испытания на мониторинг физиологических сигналов человека, что способствует развитию гибкой электронной технологии.

Ключевые слова: пьезоэлектрики, сенсоры, полимерные электреты.

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