Perfluorinated Electret Nanofiber-Based Devices for Air Filtering and Health Monitoring

Shizhe Lin and Peng Fang*

sz.lin@siat.ac.cn, peng.fang@siat.ac.cn

CAS Key Laboratory of Human-Machine Intelligence-Synergy Systems, Shenzhen Institute of Advanced Technology

Introduction

Wearable and breathable devices for air filtering and health monitoring are urgently needed since particulate matter (PM) caused a serious air pollution threatening to public health. Herein, we present dense nanofibrous membrane (PFM). The charge-rich PFM exhibits a high surface potential to realize efficient ultrafine $PM_{0.3}$ removal with low pressure drop. Furthermore, the PFM-based nanogenerator (NG) is able to detect body motion and physiological signals. The strategy of fabricating PFM provides a novel approach for obtaining charge-rich electret materials and designing healthcare devices to protect people from $PM_{0.3}$ pollution and monitor personal vital signs simultaneously.

Results and Discussion

We adopt a two-step process to fabricate PFM by using PEO as a sacrifice adhesive. Figure 1 shows the details of fabrication method.

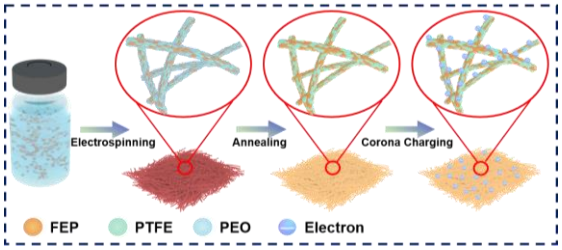

Figure 1. The fabrication method of PFM.

PFM exhibiting high $PM_{0.3}$ removal efficiency and stable surface potential can be used as the core component of air filters and fiber-based NGs. Figure 2a shows the illustration of the structure and working mechanism of PFM-based NG. The high temperature stability of PFM for removing $PM_{0.3}$ is shown in Figure 2b.

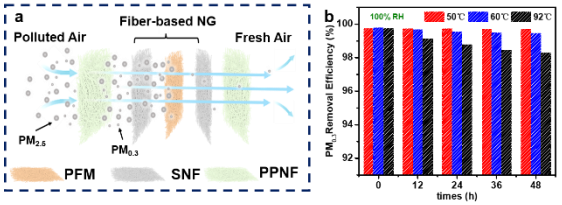

Figure 2. PFM for air filtering.

A PFM-based NG can be used as a wearable and breathable healthcare device for health monitoring, as shown in Figure 3.

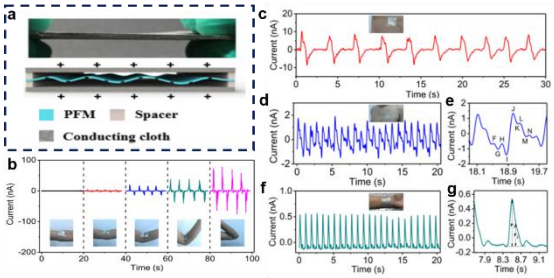

Figure 3. PFM-based NG for health monitoring.

Conclusion

In summary, we reported a facile method to fabricate charge-rich PFM for air filtering and health monitoring. This PFM owns plenty of real charges, and leading to outstanding $PM_{0.3}$ removal efficiency of 99.712% with a low pressure drop of 38.1 Pa and a high quality factor of 0.154 Pa^{-1}. Additionally, a PFM-based NG assembled by PFM and conducting cloth could act as an excellent self-powered wearable sensor that could quantitatively monitor body motion and biological signals including respiration and heartbeat. This scalable PFM with such high real charge storage capability holds great potential for practical application in air filters for ultrafine PM removing and wearable electronics for body motion and health monitoring.

References

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