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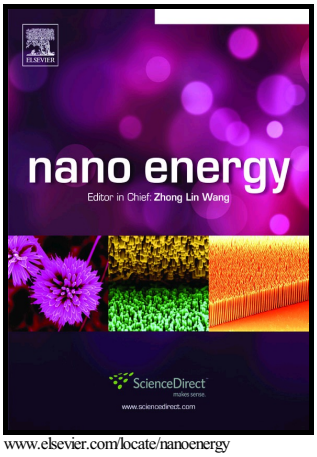

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Liquid–solid contact triboelectrification and its use in self-powered nanosensor for detecting organics in water

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Abstract

Self-powered triboelectric nanosensor (TENS) has attracted increasing attention in recent years due to its independent and sustainable operations without external power source. In this paper, we demonstrate a newly designed fully packaged liquid-solid triboelectric TENS based on the friction between polytetrafluoroethylene (PTFE) filtration membranes and water. The dependencies of output performance of water-based TENS on the water-to-cylinder volume ratio, vibration frequency and amplitude using fluid mechanics analysis are demonstrated. By modifying PTFE filtration membrane with dopamine, this TENS can be used as dopamine sensor with high selectivity and sensitivity (detection limit of 0.1 μM, a linear range from 10 μM to 1 mM). Besides, by mixing with organics (such as ethanol) to decrease the water polarity, this TENS can be used as a sensor for the detection of ethanol concentration in water with fast response at room temperature. Compared with the existing solid-solid triboelectrication based TENS, this fully packaged liquid-solid triboelectrication based TENS is portable, easily fabricated, and has potential application for detecting toxic pollutants in water with higher sensitivity.

Graphical Abstract

A fully packaged liquid-solid triboelectric TENS were fabricated basing on the friction between polytetrafluoroethylene filtration membranes and water. Compared with solid-solid triboelectrication based TENS, the liquid-solid TENS can has higher selectivity and sensitivity for detecting dopamine with the detection limit of 0.1 μM