Electrospun Sensing Materials for Monitoring Exhaled Diabetes Biomarker

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The inadequate insulin for diabetic patient results in the decomposition and oxidation of free fatty acids and increased ketone bodies and excreted in the form of exhaled breath. Therefore, breath acetone detection can be seen as an alternative to traditional finger-pricking to monitor blood glucose. In this study, we developed tin oxide/tungsten oxide/Ag/PMMA nanofibers were fabricated by electrospinning on the glass substrate for the detection of acetone in exhaled breath. For the VOCs measurement, the sensing material was placed in the middle of the container, filled with target VOCs, and started the measurement of extinction spectrum immediately. The extinction change is defined by the extinction before and after the VOC sensing. Based on our previous work, blending with Ag NPs can efficiently enhance the detection limit from surface plasmon resonances. We further blend the tin oxide for the increment selectivity, and tungsten oxide to take advantage of its gasochromic property. The addition of tin oxide did not significantly improve but decreased the response intensity. For the tungsten oxide/Ag/PMMA, the detection limit can be reduced to 75 ppm. The tin oxide/tungsten oxide/Ag/PMMA sensing material demonstrated a synergistic effect, greatly increasing the extinction change and shorten the response time. Moreover, both tin oxide and tungsten oxide are n-type semiconductors. The interfaces between tin oxide and tungsten oxide could generate more electron-hole pairs than those without such structure under light striking. Benefit from the UV-Ozone surface treatment, the surface area of the sensing material can be effectively increased, thereby increasing the sensing sensitivity of the sensing material and greatly improving the sensitivity. Finally, the sensing material can be detected within 10 min when exposed to 20 ppm acetone vapor. It is hoped that the enhanced sensitivity and accuracy of sensing materials can identify early diabetic patients.

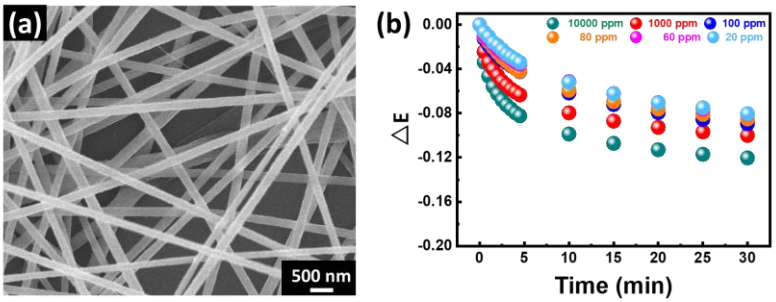

Fig 1 (a) SEM image of WO_3/SnO_2/Ag/PMMA sensing materials and (b) extinction changes when exposed to various concentrations of acetone.

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