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単結晶金属酸化物ナノワイヤを用いたフレキシブル分子センサ

Flexible Molecule Sensor using Single Crystalline Metal Oxide Nanowires

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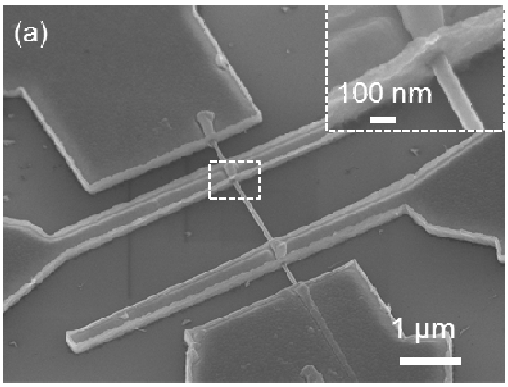
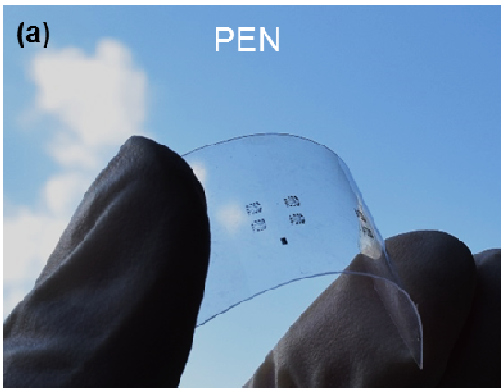
Integrating sensors for volatile molecule species into portable electronic devices is strongly desired for forthcoming sensor network society. However, high energy consumption (~mJ) and high temperature (~300ºC) required for operating conventional gas sensors have been bottleneck issues to apply these for CMOS electronics and also emerging wearable electronics. Here we demonstrate a rational sensing methodology, which substantially reduces the energy consumption of gas sensors down to ~pJ/sec. Our methodology utilizes (1) a pulse self-Joule heating of suspended SnO_2 nanowire device and (2) the short thermal relaxation time down to microseconds. These features allow us to sense volatile molecules at the energy consumption of ~pJ/sec via heating only the local sensing part up within a short time by applying a pulse voltage. We show the feasibility of the present methodology for sensing NO_2 (100ppb) by applying a pulse voltage down to microseconds. Surprisingly, the sensitivity can be significantly enhanced by utilizing the present pulse method when compared with conventional continuous heating method. Furthermore, we successfully demonstrate the applicability of the present methodology for volatile molecule sensors on flexible PEN substrate.





Related Publications

[1] J. Am. Chem. Soc., 131, 3434 (2009), [2] J. Am. Chem. Soc., 132, 6634 (2010), [3] Nano Lett., 10, 1359 (2010), [4] J. Am. Chem. Soc., 133, 12482 (2011), [5] Nano Lett., 11, 2114 (2011), [6] J. Am. Chem. Soc., 134, 134567 (2012), [7] Nano Lett., 12, 5684 (2012), [8] Sci. Rep. 3, 1657 (2013), [9] J. Am. Chem. Soc., 135, 7033 (2013), [10] ACS Nano, 7, 3029 (2013), [11] Sci. Rep. 4, 5252 (2014), [12] J. Am. Chem. Soc., 136, 14100 (2014), [13] Sci. Rep. (2015) in press