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An ultrasensitive and humidity resistant NO_2 gas sensor based on BP-BV composite film at room temperature

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Abstract

In this paper, black phosphorus (BP) based thin film serving as a sensing layer was prepared for trace-level nitrogen dioxide (NO_2) gas detection within different relative humidities (R.H.). Meanwhile, multiple characterization techniques containing TEM, XRD, XPS and Raman were employed to auxiliarily unveil the gas-sensing mechanism. Benzyl viologen (BV), owning one of the highest reduction potentials of all electron donor organic compounds, was incorporated into BP flakes, and thus resulted in a sensing response of 86% toward 100 ppb NO_2 at 40% RH, which was nearly 400% enhanced in comparison with bare BP one. Furthermore, we investigated the role of BP or BV material in the sensing performance. It was concluded that the composites showed a high sensitivity toward trace NO_2 gas, and the humidity posed a negligible effect on NO_2 sensing.

Key words: black phosphorus; humidity resistant; gas sensor; room temperature;