UV assisted NH$_3$ Gas Sensor based on Ternary Reduced Graphene Oxide/TiO$_2$/Au composites at Room Temperature

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Abstract:

Ammonia gas is a hazardous gas species, which will impose great threat on human health and ecological environment. Thus, it is of great importance to selectively and sensitively detect NH$_3$ gas at low level. In this report, we adopt hydrothermal method to prepare ternary composites of reduced graphene oxide nanosheets (rGO), TiO$_2$ nanotubes and Au nanoparticles, and then probe NH$_3$ gas spanning from 1 ppm to 10 ppm under UV illumination (365 nm) at room temperature (25 °C). Within the composites, rGO nanosheets serve as a template to provide attachment sites of TiO$_2$ and Au, and suppress their aggregation via the steric hindrance effect. TiO$_2$ nanotubes as a typical UV light-sensitive material contribute a mass of photogenerated electron-hole pairs, which will well react with exposed NH$_3$ molecules. Meanwhile, incorporation of Au nanoparticles could significantly increase the sorption sites due to the spillover effect. As expected, the as-prepared sensors enable a room-temperature detection response of 10% toward 1 ppm NH$_3$ under UV illumination as well as an excellent selectivity, repeatability and long-term stability, which is far incapable for other prepared ones based on random binary composites or individual component. In brief, the ternary sensors have exhibited huge superiority in trace-level NH$_3$ detection in terms of low-power consumption and high sensitivity.

Key words: NH$_3$ gas sensor, reduce graphene oxide, TiO$_2$, Au nanoparticle, UV illumination