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# **ZIF-8 derived hexagonal-like $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO/Au nanoplates with tunable surface heterostructures for superior ethanol gas-sensing performance**

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## **Abstract**

A series of hexagonal-like  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO/Au nanoplate heterostructures with tunable morphologies and superior ethanol gas-sensing performance were successfully synthesized via the facile multi-step reaction processes. Hexagonal-like  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> nanoplates with uniform size around 150 nm are employed as new sensor substrates for loading the well-distributed ZnO and Au nanoparticles with adjustable size distribution on the different surfaces. Brunauer-EmmeQ-Teller (BET) surface areas of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> and  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO samples are evaluated to be 37.94 and 61.27 m<sup>2</sup>/g, respectively, while  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO/Au composites present the highest value of 79.08 m<sup>2</sup>/g. These  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>-based functional materials can exhibit outstanding sensing properties to ethanol. When the ethanol concentration is 100 ppm, the response value of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO/Au composites can reach up to 170, which is 14.6 and 80.3 times higher than that of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO and pure  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>, respectively. The recycling stability and long-time effectiveness can be availably maintained within 30 days, as well as the response and recovery times are shortened to 4 and 5 s, respectively. Significantly, the response value of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/ZnO/Au composite is still up to 63 at an operating temperature of 280 °C even though the ethanol concentration decreases to

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