Electronic Supplementary Information (ESI)

A CO₂ Optical Sensor based on Self-Assembled Metal-Organic Framework Nanoparticles

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Figure S1. (a) Representative FE-SEM image of nanoZIF-8 (size = 32 ± 5 nm) and corresponding size-distribution histogram. (b) Representative FE-SEM image of nanoZIF-8 (size = 53 ± 8 nm) and corresponding size-distribution histogram. (c) Representative FE-SEM image of nanoZIF-8 (size = 70 ± 12 nm) and corresponding size-distribution histogram. (d) Simulated (grey) and experimental XRPD patterns of nanoZIF-8 particles with a size of 32 ± 5 nm (blue), 53 ± 8 nm (red) and 70 ± 12 nm (black). (e) N₂ sorption isotherm at 77 K of CTAB-coated nanoZIF-8 particles with a size of 32 ± 5 nm (blue), 53 ± 8 nm (red) and 70 ± 12 nm (black). Respective BET surface areas: 1488, 1480 and 1471 m²/g (theo-expected = 1300-1500 m²/g). (f) Visible transmission spectra of the films made of the self-assembly of CTAB-coated nanoZIF-8 particles with a size of 32 ± 5 nm (blue), 53 ± 8 nm (red) and 70 ± 12 nm (black). Scale bars: 500 nm.
Figure S2. (a) Responses to 100% CO₂ (blue) of nanoZIF-8-based BiMW sensors made of different nanoZIF-8 films, which thickness (red) has been tuned by spin coating (spinning speed: 2000 rpm; time: 1 min; acceleration: 250 rpm/s) nanoZIF-8 colloids of different concentrations. (b) Responses to 100% CO₂ (blue) of nanoZIF-8-based BiMW sensors made of different nanoZIF-8 films, which thickness (red) has been tuned by spin coating a nanoZIF-8 colloid (concentration: 60 mg/mL; time: 1 min; acceleration: 250 rpm/s) at different spinning speeds from 2000 rpm to 6000 rpm.
Figure S3. (a) Optical image of a single bimodal waveguide sensor showing the cracking of the CTAB-coated nanoZIF-8 film after nanoZIF-8 is activated (Left). Optical scattering image of a sensor chip when the light from a 660 nm red laser source is coupled in a bimodal waveguide, showing the complete loss of light transmission through the waveguide (Right). (b) Optical image of a single bimodal waveguide sensor with a first layer of activated CTAB-coated nanoZIF-8 and a second layer on top of PDMS, showing the absence of cracking once nanoZIF-8 is activated (Left). Optical scattering image of a sensor chip when the light from a 660 nm red laser source is coupled in a bimodal waveguide, showing the light transmission through the waveguide (Right).
Figure S4. Gas system for the controlled mixture of different gases. Photograph of the gas sensing cell with the O-ring on top of the sensor chip and the Peltier element behind.
Figure S5. (a) FE-SEM image of the bare chip. (b) FE-SEM image of a BiMW sensor containing only the PDMS film. Scale bars: 5 µm.
Figure S6. Real-time signals for the detection of (a) 80% CO₂, (b) 60% CO₂, (c) 40% CO₂ and (d) 1% CO₂ at RT.
**Figure S7.** Adsorption isotherms of nanoZIF-8 by using CO$_2$ at 278 K (black), CO$_2$ at 293 K (blue), N$_2$ at 278 K (yellow), and N$_2$ at 293 K (red).
Figure S8. Sensor response to 25% CO$_2$ at relative humidity (RH) levels of 0%, 25%, 50% and 75%.
Figure S9. Sensor response for 1 bar of N₂, CO₂ and CH₄.