3- Membranes for gas nano-sensors

MOF-based membrane encapsulated ZnO nanowires for enhanced gas sensor selectivity
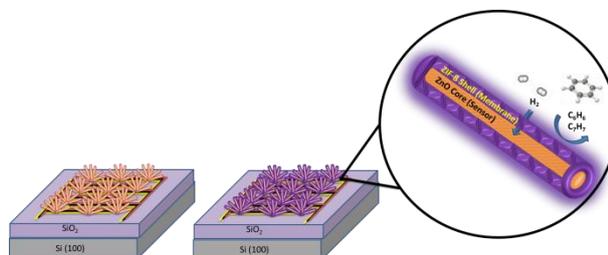*ACS Appl. Mater. Interfaces 8 (2016) 8323–8328.*

Collaborations: Inha University - South Korea
Involved MCP researchers: Martin Drobek, Anne Julbe

Gas sensors are of a great interest for applications including toxic or explosive gases detection in both in-house and industrial environment, air quality monitoring, medical diagnostics or control of food/cosmetic properties. In the area of semiconductor metal oxides (SMOs)-based sensor, a lot of effort has been devoted to improve the sensing characteristics. In this work, we report on a general methodology for improving the selectivity of SMOx sensors based on the coverage of ZnO nanowires with a thin ZIF-8 selective membrane barrier exhibiting molecular sieving properties. The as-prepared ZnO/MOF-based nanocomposite sensor shows improved sensitivity ratios of $(S_{H2})/(S_{C7H8})$ and $(S_{H2})/(S_{C6H6})$ reaching for 10 ppm concentration up to 3.5 and 2.8 times higher enhancement, respectively in comparison to the pristine ZnO nanowires sensor. This original strategy can pave the way for different types of applications, where gas or ionic selectivity is required such as sensing, biosensing, photo(catalysis) and electrodes.

High Performance Nanowires Hydrogen Sensors by Exploiting the Synergistic Effect of Pd Nanoparticles and MOF Membranes
Applied Materials & Interfaces 10 (2018) 34765-34773.

Collaborations: Inha University - South Korea
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The sensor device is based on the strategic combination of ZnO nanowires (NWs) decorated with palladium nanoparticles (Pd NPs) and a molecular sieve metal organic framework (MOF) nanomembrane (ZIF-8). The Pd NPs permit the sensors to reach maximal signal responses, whereas the ZIF-8 overcoat enables for an excellent selectivity. Three steps were employed for the fabrication: i) coating of a miniaturized sensor with vapor grown ZnO NWs, ii) decoration of these NWs with Pd NPs by atomic layer deposition (ALD), and iii) partial solvothermal conversion of the tuned NWs surface to ZIF-8 nanomembrane. The integration of these nanomaterials within a miniaturized sensor device enabled the assessment of their performance for H_2 detection at concentrations as low as 10 ppm in the presence of various interfering gases such as C_6H_6, C_7H_8, C_2H_5OH and CH_3COCH_3.