Highly Selective and Sensitive Detection of Methylbenzenes via Concurrent Control of the Gas Reforming and Filtering in Catalytic Oxide Overlayer.

Jun-Sik Kim¹, Hyun-Mook Jeong¹, Jae-Hyeok Kim¹, Bo-Young Kim¹, Ho Won Jang², Jong-Heun Lee¹
¹Department of Materials Science and Engineering, Korea University, Seoul 02841, Republic of Korea
²Department of Materials Science and Engineering, Research Institute of Advanced Materials, Seoul National University, Seoul 08826, Republic of Korea
jongheun@korea.ac.kr

Abstract
A Co₃O₄ gas sensor coated with catalytic oxide overlayer was fabricated by screen printing of Co₃O₄ yolk-shell spheres on the substrate and subsequent deposition of SnO₂ or TiO₂ catalytic overlayer by e-beam evaporation. Co₃O₄ gas sensors with TiO₂ and SnO₂ overlayer (thickness: 5 nm) showed high responses (resistance ratios) to 5 ppm xylene (14.5, 28.8) and 5 ppm toluene (11.7, 16.2) at 250 °C and exhibited excellent selectivity against other interfering gases such as ethanol, HCHO, CO, and benzene. In contrast, the pure Co₃O₄ gas sensor did not show high selectivity toward any specific gas. The excellent selectivity to methylbenzenes was attributed to catalytic reforming of less reactive methylbenzene into more reactive and smaller species and catalytic oxidation of reactive interference gases such as ethanol and HCHO at catalytic overlayer. These concurrent tuning of the gas reforming and oxidative filtering processes using a nanoscale catalytic oxide overlayer provides a new, general, and effective method for fabricating highly selective and sensitive metal oxide semiconductor gas sensors.

Key words: Co₃O₄ gas sensor, methylbenzenes, catalytic overlayer, gas reforming, gas filtering