Sulfur-Assisted WO3 nanospheres for Enhancement of NO2 Gas Sensing

Jun-Cheol Park, Sanghan Lee

*School of Materials Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju, 61005, Korea*

Various hollow structures with high surface-to-volume ratio, reduced mass, and great charge transport properties are one of the remarkable candidates which could be utilized in gas sensors, ion batteries, capacitors, photocatalysis, fuel cells, and so on. Among these practical applications, research on the gas sensor is significantly important owing to accelerating of the 4th industry such as Internet of Things (IoT), healthcare. Although there are various fields in which gas sensors are utilized, there are still existing many challenges to be solved, such as detecting very low concentrations of sub-ppm level (i.e. limit of detection) or fast detection speed. Although the noble metal catalysts such as Pt, Au, and Pd introduced for overcoming these limitation, those are difficult to be practically utilized owing to their competitive price.

Herein, we successfully synthesized sulfur-assisted WO3 hollow nanospheres via two-step process : firstly, bare WO3 nanospheres were synthesized via conventional hydrothermal synthesis; second, as-synthesized WO3 nanospheres and sulfur powders were mixed in autoclave to induce chemical reaction. The presence of sulfur in WO3 nanospheres were confirmed by XPS, and EDX. Sulfur-assisted WO3 nanospheres exhibited about 30 times better NO2 sensing properties compared to bare WO3. To clarify the mechanism of superior performance, XPS analysis was performed using three types of S:WO3 (pristine, NO2-exposed, air-recovered). Our research not only showed the potential for improved sensing performance despite the introduction of a low-cost catalyst, but also elucidated the role of oxygen vacancies in chemical gas sensing using WO3.