

Spatial Atomic Layer Deposition of Metal Oxide Nanofilm and Noble Metal Catalysts for Gas-Sensing Applications

Nguyen Van Hieu*, Nguyen Viet Chien, Phan Hong Phuoc, Nguyen Ngoc Viet, Nguyen Viet Huong, Bui Van Hao

Phenikaa School of Engineering, Phenikaa University, Hanoi, Viet Nam

**email: hieu.nguyenvan@phenikaa-uni.edu.vn*

Abstract:

Atomic layer deposition (ALD) is a well-known and IC-compatible method for integrated circuit technology. Therefore, this approach plays an important role in the large-scale fabrication of semiconductor metal oxide gas sensors using microelectronic fabrication processes.

In this presentation, we report a new strategy for fabricating metal oxide nanofilms and sub-1 nm Pt nanoparticles for gas-sensing applications. ZnO nanofilms prepared under different conditions were investigated for gas sensing applications. The ZnO nanofilm sensor exhibited an ultrahigh response to NO₂ under UV irradiation, with a response of approximately 2100 toward 10 ppm NO₂ and a low detection limit of approximately 16 ppb. The ZnO nanofilm was also employed to develop multi-gas sensors for the detection and discrimination of NO₂, H₂S, ethanol, and acetone using machine learning algorithms. In addition, ALD was demonstrated as an effective method for preparing TiO₂-modified polyvinylidene fluoride porous fiber membranes for self-powered humidity sensing based on direct-current triboelectric nanogenerators. These results indicate that the PTPF membrane can serve as a multifunctional platform bridging efficient energy conversion and environmental sensing. Overall, these findings demonstrate that ALD provides a flexible and scalable approach for preparing advanced gas-sensing materials.

Keywords: Oxide gas sensors; Nanofilm; ALD; Gas separation; Self-power sensors; Benzene; Reactors; Selectivity <Format: Arial, 10pt>