Role of organic molecules: From functional device to sensing application

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Abstract

Immobilization or doping organic molecules into inorganic material can alter the material surface property and provide active functions such as gas molecular capturing, molecules conversion, and conductivity tuning. Molecules can be applied onto the solid substrate as a monolayer by self-organizing organic molecules in a solution or vapor environment or achieved as a polymer composite by different coating techniques. The study here includes the demonstration of molecular doping in the semiconductor device, showing the ultra-shallow doping profiles and integrating them into 3D structural device fabrication. Besides, we also utilize molecular interactions from organic monolayer to immobilize 2D materials, MXene (Ti3C2Tx), onto a defined area in solid support. This allows us to explore the gas-sensing behavior of MXene materials further and study their sensing response consistency after layer-by-layer assembly with PANI polymer. To broaden more gas sensing applications, we are also working on optical-based polymer sensors to have better flexibility for device integration. However, polymer normally has a low refractive value (average 1.50) precludes it from being used in advanced optical applications. Therefore, several polymers with different side groups or metal oxide nanoparticle inclusion are optimized to enhance their refractive index while maintaining transparency. Such reinforced polymer composite will be used to fabricate a grating structure that can generate resonance effects for sensing applications (Guided-Mode Resonance sensor). With all the above mentioned, one can picture the great potential of organic molecules for their wide application from electronic devices to gas sensing devices.

Zoom link: https://syddanskuni.zoom.us/j/68860359066

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