Liquid precursor-based Chemical Vapor Deposition and Transfer of Monolayer MoS_2 on GaN

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Molybdenum disulfide (MoS_2) is a transition metal dichalcogenide with a direct bandgap in its monolayer form, making it highly attractive for electronic and optoelectronic applications. When combined with gallium nitride (GaN), a wide-bandgap semiconductor known for its high electron mobility, thermal stability, and optical properties, the resulting heterostructure can leverage the advantages of both materials.

In this study, we explore the synthesis and transfer techniques of two-dimensional (2D) MoS_2 on GaN, focusing on advancements in chemical vapor deposition (CVD) using liquid precursors. The use of liquid precursors allows for the formation of uniform, large-area, high-quality MoS_2 monolayers. This technique offers advantages such as improved scalability and better control over the thickness, morphology, and crystallinity of the MoS_2 flakes.

Furthermore, we have developed a transfer process and a tool that enables the controlled transfer of the MoS_2 layers grown on SiO_2/Si to GaN substrates.

The combination of liquid precursor-based CVD growth and transfer techniques opens up new possibilities for the integration of 2D materials in advanced nanoelectronic and optoelectronic devices. The growth and transfer methods will be compared, discussing the pros and cons of each approach in integrating MoS_2 on GaN substrates. This research, part of the PRIN2022 project “2DIntegratE” (2022RHRZN2), underscores the importance of innovative material synthesis and processing techniques in pursuing cutting-edge technological advancements.