Laser Irradiation Controlled Liquid Molecule Intercalation within Confined Spaces: Diversity and Dynamics

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Abstract
Understanding mass transport within confined spaces is a key challenge with broad implications across numerous scientific and engineering disciplines.[1] While studies on channel size effects and channel wall dynamics have deepened our knowledge of material transport, the combined analysis of both factors remains underexplored.[2-4] This study reports on a fatty acid, heptanoic acid, that spontaneously intercalates into graphene/SiO_2 in its gaseous state but is controllably intercalated in its liquid state through laser irradiation (Figure 1). Leveraging the diverse local properties of the system—such as the confined spaces between flexible graphene and atomically rough SiO_2—we employed time-course Raman spectroscopy to record and analyze multiple dynamic molecular intercalation processes. Through systematic analysis, we propose a model based on the dynamic changes of three key parameters: graphene doping, strain, and 2D-band intensity (I_{2D}) during the liquid molecular intercalation process, derived from time-course Raman spectroscopy data. Additionally, we explore the mechanisms by which laser irradiation regulates molecular intercalation behavior. This study provides a foundation for understanding and optimizing molecular transport within graphene-based systems featuring confined spaces.[5]

References

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Figures

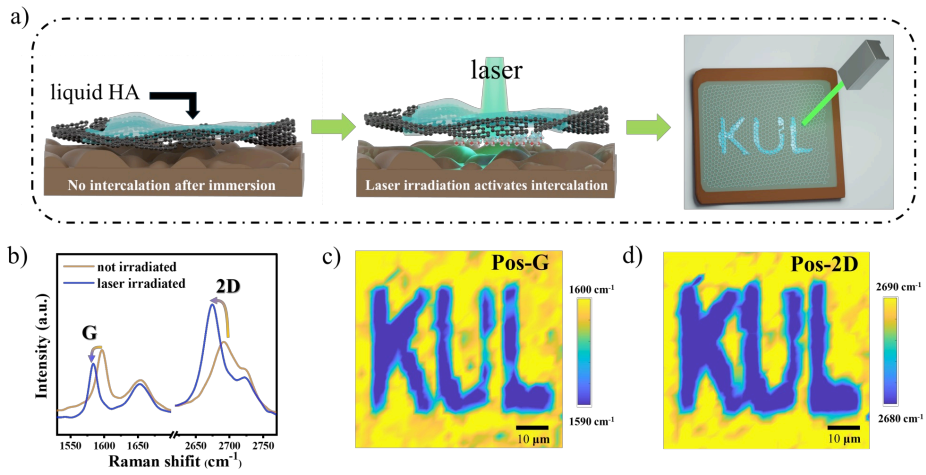

Figure 1(a) Schematic of laser irradiation controlled molecular intercalation in the liquid phase. (b) Raman spectra of regions with and without laser irradiation. (c-d) Raman mapping of the spatial distribution of (c) Pos-G and (d) Pos-2D induced by laser irradiation.