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Structural Modifications of Copper Metal-Organic Framework HKUST-1 Under UV and IR Laser Irradiation

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Introduction. Metal-organic frameworks (MOFs), a class of materials distinguished by their unique structural and chemical properties, have garnered significant attention across various scientific fields [1]. The intriguing aspect of MOFs lies in their response to external stimuli, such as laser irradiation, which can induce notable changes in their optical and structural characteristics. This study focuses on HKUST-1, a widely studied MOF, and explores its behavior under different laser irradiations. The application of UV and IR laser irradiation on HKUST-1, both on a plain quartz substrate and on a quartz substrate coated with a thin layer of titanium, presents a unique opportunity to investigate these effects. The key objective is to elucidate how laser irradiation in different spectral regions affects the MOFs' structural and optical properties, including aspects such as reflection, transmission, refractive index, extinction coefficient, and energy bandgap.

Main Part. Our study examines the impact of UV and IR laser irradiation on HKUST-1 MOFs, specifically targeting samples prepared on two distinct substrates: plain quartz and quartz coated with a thin titanium layer. We deploy an array of advanced spectroscopic and microscopic techniques to dissect the intricate changes in the transmission and reflection properties of HKUST-1 following laser exposure. This comprehensive analysis aims to illuminate the precise laser parameters that facilitate structural modifications in the HKUST-1 crystalline framework. Our research delves into the nuances of how different wavelengths and intensities, characteristic of UV and IR lasers, uniquely interact with and alter the MOF structure and its optical properties [2].

An important aspect of this inquiry is identifying the ablation and modification thresholds of HKUST-1 under diverse laser irradiation scenarios [3]. Discerning these thresholds is paramount in understanding the limits of laser parameter tuning that can instigate alterations in the MOF's structure and properties, without causing significant material degradation or loss. This exploration is crucial in advancing our understanding of the resilience and adaptability of HKUST-1 MOFs under varied photonic influences, thereby broadening their potential applications in photonics and material science.

Conclusion. This investigation into the laser-induced modifications of HKUST-1 MOFs has yielded valuable insights into the influence of laser parameters on their crystalline and optical properties. It has also helped establish the ablation and modification thresholds for HKUST-1 under laser irradiation. The findings pave the way for future research exploring the application of laser irradiation on MOFs with varied structures and chemical compositions. This study contributes significantly to the expanding knowledge base regarding the interaction of MOFs with laser irradiation, highlighting its potential in novel applications and material modifications.

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