



Laser Induced Thermal Desorption of Carbon Surfaces: High space-time resolution temperature measurements

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Due to their remarkable properties (high electrical/thermal conductivity, high tensile strength, low weight and low cost), carbon-based materials are widely used across various fields, ranging from aerospace and automotive to medicine and environmental applications. These materials may also exhibit high specific surface area, which contributes to their high adsorption capacity and makes them suitable for applications in filtration, gas storage, or catalysis. In a previous paper [1], we introduced a novel method, based on laser-induced thermal desorption (LITD) and mass spectrometry detection, that enables the investigation of adsorption processes on carbonaceous surfaces with sub-millimeter-scale heterogeneities. Adsorption energies of polycyclic aromatic hydrocarbons (PAH) and other compounds (metal salts) on various carbon materials, such as soot, graphite, and highly-oriented pyrolytic graphite (HOPG), were determined with a lateral resolution defined by the laser spot size. In this first study, the adsorption energy was calculated using a Bayesian statistical approach (Monte Carlo Markov Chains - MCMC) combined with simulated space-time temperature profiles of the laser-irradiated area. In order to remove simulation-related uncertainties and strengthen the fitting process, the use of directly measured experimental temperature profiles with high spatial and temporal resolution is preferable.

Within this framework, we developed a high-resolution experimental method to measure the surface temperature profiles of carbon-based surfaces (specifically, HOPG), by combining nanosecond laser-induced heating with optical pyrometry of the incandescence signal, using a custom-built detection system. The developed method achieved measurement of temperature profiles with nanosecond temporal resolution (~ 3 ns) and micrometer spatial resolution (~ 17 μ m), significantly improving upon previous studies [2-3]. The experimentally determined temperature profiles were further used to calculate the desorption rate of a PAH molecule (such as pyrene) adsorbed on HOPG at sub-monolayer coverage.

Acknowledgements: The authors acknowledge the CaPPA project (Chemical and Physical Properties of the Atmosphere) that is funded by the French National Research Agency (ANR) through the PIA (Programme d'Investissement d'Avenir) under contract ANR-11-LABX-0005-01 for their partial support. The authors thank the Région Hauts-de-France, the Ministère de l'Enseignement Supérieur et de la Recherche and the European Fund for Regional Economic Development for their financial support to the CPER ECRIN program.

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