10th Euro-Mediterranean Symposium on Laser-Induced Breakdown Spectroscopy

EMSLIBS 2019

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Double-pulse laser synchronization aimed at simultaneous detection of intensified atomic and molecular signals for space exploration

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A double pulse laser system that combines Raman spectroscopy and laser induced breakdown spectroscopy (LIBS) using one laser and one ICCD is demonstrated. The study attempts to improve the atomic signals of LIBS while simultaneously extracting the desired molecular signals from Raman. In low pressure conditions such as the lunar atmosphere, the detection of plasma emission is difficult due to the low electron density and short persistence time causing a rapid plasma expansion. Moreover, in the integration of the spectroscopic system aimed at space exploration, the system size and weight should be minimized. Simultaneous molecular and atomic detection that gave highly resolved spectra of both LIBS and Raman at pressure below 0.07 torr is achieved. First, a low-energy laser pulse was used to produce a small plasma and to detect the molecular signals through the inelastic scattering effect. Then, the laser pulse at a higher energy is used to produce a larger plasma plume for detecting the atomic signals. Amongst eight rock samples tested, plasma stacking by generating two sequential plasmas produced from the double-pulse laser on Calcite for example enhanced the signal intensities of calcium and oxygen lines by twofold, compared to a conventional LIBS. Noting the importance of discriminating the type of minerals during space exploration, the signal enhanced plasma emissions from the present setup may lead to highlighting the features of weak spectra and detecting otherwise blind signals from the conventional LIBS setup.

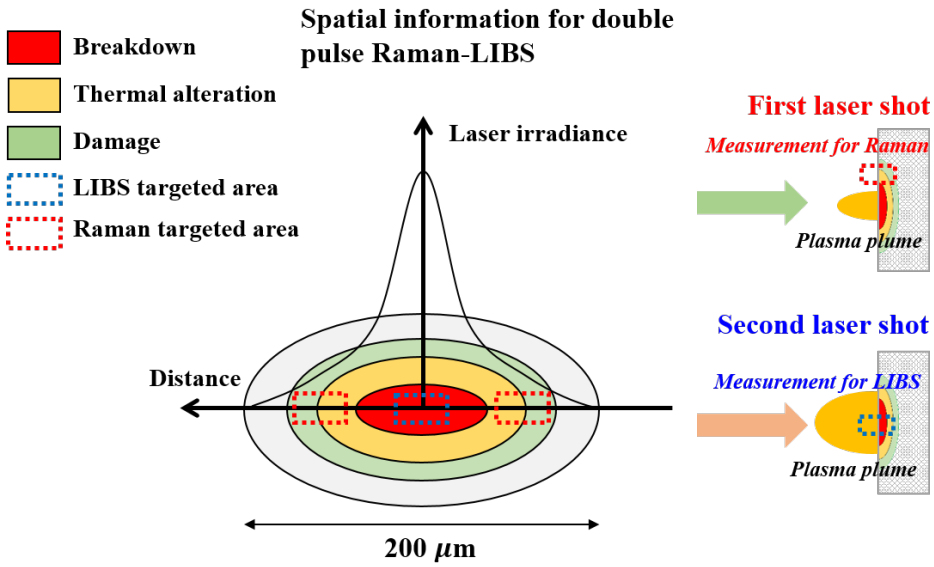

Fig1.: Schematic of the proposed double pulse Raman-LIBS arrangement

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