

Double pulse laser induced plasma spectroscopy for REE element analysis

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Laser induced breakdown spectroscopy (LIBS) is based on focusing a laser beam on a sample to create a plasma at the sample surface. The chemical composition can then be determined by analyzing the emission spectra from the plasma. LIBS has numerous advantages compared to other techniques, as it allows very fast measurements, can be employed in the field, requires no sample preparation, and consumes only tiny amounts of sample [1]. The detection limits and sensitivity of LIBS depends on the sample and is element dependent. One possibility to significantly improve the sensitivity of LIBS is to employ a second laser pulse. An enhancement of the emission by a factor of 25-300 (depending on the emitting species) has been reported using double pulse LIBS [2].

LIBS has been used very infrequently for the analysis of rare earth elements, REE. Until now, only an analysis of rare earth doped (Nd, Eu, Er, Ho) optical glasses [3], of Sm, Eu and Gd in aqueous solution [4] and an identification of REE in a geological sample [5] have been reported. No studies of REE using the double pulse LIBS technique have been published up to now. To explore the opportunities offered by the double pulse LIBS technique we have performed double pulse LIBS experiments on several reference materials (IGS-40, IGS-41, NIM-18/69, OREAS-146, SY-4 and GSP-1) and a REE- containing carbonate sample from Lugiin Gol (Mongolia). The double pulse LIBS experiments were performed with a Q-switched Nd: YAG laser system (1.064 μ m) and a CO₂ laser (10.6 μ m) with a pulse width of 6 ns and 8 μ s, respectively. The second laser was triggered with a pulse/delay generator. The delay between laser pulses was varied in the range from 1 to 20 μ s. The LIBS signal is slightly enhanced and several new emission lines were detectable when employing the CO₂ laser to provide a second pulse.

We will present results describing the optimal choice of experimental parameters and will discuss the opportunities offered by this technique for the chemical analysis of geological samples.

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