

High-speed LIBS imaging for large format samples

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Laser-induced breakdown spectroscopy (LIBS) has become a very popular technique for spatial determination of trace and major elements. LIBS offers the ability to measure C, H, O, N, and F which is often difficult or unattainable by laser ablation – inductively coupled plasma mass spectrometry (LA-ICPMS). In some examples, samples may exist with a rather ($>25\text{ cm}^2$) large 2-dimensional (2D) foot print, while requiring spatially resolved elemental analysis. In such instances, larger samples that may not be readily suitable for standard laser ablation chambers; therefore, requiring a different sampling interface. While LA-ICPMS can perform high-speed imaging at 1000 Hz, it requires small spot sizes and fast single pulse responses ($< 10\text{ ms}$). For very big samples, larger spot sizes are required in order to keep the analysis to a reasonable timeframe. In this case, LIBS is the ideal choice since there is no dependence on the pulse response and the true speed of the measurements can be achieved.

Here we demonstrate a new, large format, high-speed LIBS instrument for analyzing samples that can be as large as 500 cm^2 . This system uses a multi-channel complementary metal-oxide-semiconductor (CMOS) spectrometer to collect the spectral signal from 190 – 1100 nm. The laser utilized in this work was a 193 nm ArF excimer laser, operated at 1000 Hz and with a $100\text{ }\mu\text{m} \times 100\text{ }\mu\text{m}$ laser spot size. All LIBS data was processed using iolite V4, which included peak integration, calibration, and elemental images. The samples analyzed in this work include granitic pegmatite, tourmaline in granite, turgite, quartz, lazulite, jasper, and lime. These samples were roughly 4-8 cm in width and 10-18 cm in length and were all analyzed in ≤ 35 minutes each. This method resulted in an output of ~ 1.75 million pixels/h.