Expanding LIBS Capabilities with LAMIS and ICP-MS

RICHARD E. RUSSO

Lawrence Berkeley National Laboratory, Berkeley, USA, *rerusso@lbl.gov*
Applied Spectra, Inc, Fremont,CA USA

The basis of LIBS is laser ablation; the process of using a short pulsed laser beam to remove mass from a sample. Laser ablated mass is transformed into a luminous optical plasmas that condenses to a fine aerosol as the plasma expands and cools. Time-delayed optical emission from the luminous plasma at the sample surface can be monitored to provide direct elemental analysis of the sample (LIBS). The condensed aerosol also can be transported to an Inductively Coupled Plasma Mass Spectrometer (ICP-MS) for sensitive isotopic analysis. Generally, LIBS is not considered for isotopic analysis due to poorly resolved isotopic spectral shifts in atomic and ionic emission spectra, especially for laser plasmas initiated in atmospheric pressure. A new technology LAMIS (Laser Ablation Molecular Isotopic Spectroscopy) allows precision isotopic measurements in laser plasmas at atmospheric pressure by extending the delay time after the laser pulse and measuring molecular spectral emission as the plasma cools. Isotopic spectral splitting can be up to several orders of magnitude greater in molecular emission spectral bands compared to atomic and ionic lines. By expanding the capabilities of classical LIBS to include the measurement of molecular emission spectra in addition to atomic and ionic lines, LAMIS provides the ability to measure all elements and their isotopes, especially light elements like Li, Be, C, N, O which are impossible with XRF. We developed LAMIS to date by demonstrating its ability to measure B, C, H, D, Sr and other isotopes. For some isotopes, we have achieved < 0.1% precision. By coupling LIBS/LAMIS with ICP-MS, the dynamic range in elemental and isotopic sensitivity is expanded by orders of magnitude. The talk will provide an overview of the laser ablation process, properties of the optical plasma and aerosol, and examples of simultaneously detection using LIBS, LAMIS and ICP-MS, providing a complete toolbox for measuring every element on the periodic chart with every laser pulse.