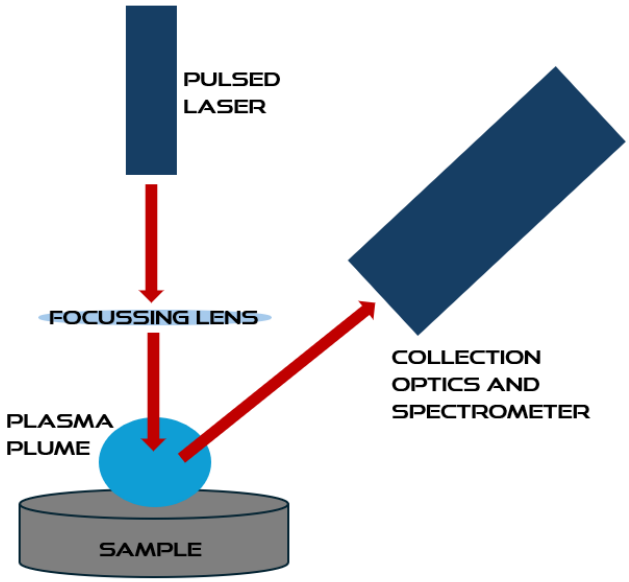
ARUN TECHNOLOGY

APPLICATION NOTE

PRINCIPLES OF LIBS



Laser Induced Breakdown Spectroscopy (LIBS) is a type of Optical Emission Spectroscopy (OES) used to measure elemental composition of materials. Rather than using a spark, in LIBS a laser pulse is focussed onto a microscopic point and used to ablate ~1ng of material from the surface of the sample to generate a plume of plasma in the temperature range 4700-19700ºC. In the plasma, the sample material is dissociated into atoms and partially ionised. When these ions are excited, electrons will transition to higher energy levels and then when returning to their ground state will emit photons at a characteristic wavelength for each element.

The emitted light is transmitted through optical fibres and dispersed by diffraction gratings into multiple spectrometers, where the wavelengths are detected by CMOS detector chips.

The emitted spectrum from a material can contain hundreds or even thousands of lines, with the sensitivity of those lines differing by several orders of magnitude especially in samples containing high concentrations of transition elements like stainless steel alloys. The dispersion power of a LIBS system, and therefore its resolution, is often limited by its size and so some lines may not be fully resolved by the system.

Wavelengths below 200nm (e.g. C 193.09nm and S 180.73nm) are strongly absorbed by air, meaning an argon purge of the optical path is required for the detection of such lines. The ARUN Technology CALIBUS 5 is equipped with an internal argon canister to enable its capability to detect carbon in ferrous samples, covering a wavelength range of 190-680nm.

Almost any element contained in most standard alloys can be detected using LIBS – sensitivity for alkaline (Li, Na, etc) and alkaline-earth (Be, Mg, etc) metals is very high, and sensitivity for transition metals is good. Some refractory element such as Nb, Mo, W, and Ta can be difficult to determine. Sensitivity for P and S is generally insufficient for the analysis of these elements at the relevant levels in alloys, but C can be detected in carbon steel and cast iron.