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## WHITE PAPERS & APPLICATION NOTES



### Compact, self-contained pulsed lasers expand capabilities in LIBS applications

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**LIBS basics**  
Laser-induced breakdown spectroscopy (LIBS) is an atomic emission spectroscopy technique that enables rapid elemental analysis of a wide range of materials including metals, semiconductors, glasses, biological tissues, plastics, soils, thin and paint coatings. The technique relies on focusing short high energy laser pulses onto the surface of a target sample which in turn generates a plasma containing a small amount of the sample (typically a few nanograms). The high temperatures generated within the plasma cause the ablated material to dissociate into excited atomic and ionic species which emit characteristic spectral lines upon relaxation. The spectrum of the investigated sample is then detected by a spectrometer and is converted into a quantitative or qualitative reading of the material content.

The simplicity of the LIBS analytical method together with the absence of sample preparation requirements makes it a powerful non-contact (or stand-off) optical technique. The versatility of the LIBS technique means that a broad range of application areas can also be addressed. For example, compact hand-held LIBS devices are suited to fast material identification in the field while larger tabletop systems can be used for routine material quality monitoring and research, and even larger industrial LIBS systems address the need for inline analysis of metals (e.g. in scrap metal sorting systems, aluminium and steel production processes, slag and lime-ore).

The laser requirements for each of these types of LIBS systems can also vary. For instance, portable handheld systems require compact and power efficient lasers by nature whereas larger industrial LIBS systems require high-energy pulsed lasers and are not necessarily concerned about the dimensions of laser sources. These high-energy pulsed lasers are often quite bulky due to the size of the laser heads, drive electronics and cooling systems. They also sometimes produce low-quality beams which are difficult to focus into small spots and consume a fair amount of electrical power. For these reasons, they work well for larger scale LIBS systems with large focal depth and fast-moving samples, but they are less suited for portable devices or compact tabletop systems.

**Lasers for compact & fast LIBS systems**  
An alternative for smaller but still powerful LIBS systems is the Cobolt Zap™ 20. This laser is a compact air-cooled passively Q-switched diode-pumped solid-state laser (DPSSL) providing 0.5 mJ/pulse energies at 10 Hz with 100 ns repetition rates and in a high-quality beam (M<sup>2</sup> < 1.2). The most critical parameters for LIBS applications is the energy density of the laser pulse and the peak power, which must exceed the ablation threshold of the analysed material (ref. 1,2,3). Due to the excellent TEM<sub>00</sub> beam quality of all lasers within Cobolt Zap™ series, and the Cobolt Zap™ 20 in particular, it is possible to focus the nearly diffraction limited beam into a small area, and thereby reach sufficiently high pulse energy density and peak power to ablate the material and produce a plasma of excited atoms and ions without melting the material.



Figure 1. Cobolt Zap™ 20 laser head (100 x 60 x 30 mm) with trigger and electronics on an air-cooled heat sink (100 x 60 x 100 mm). No external electronics or cooling systems are required.

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