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Laser-Induced Breakdown Spectroscopy

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Laser-Induced Breakdown spectroscopy (LIBS) is a powerful analytical technique used to determine the chemical composition of a sample, by examining the light emitted from a plasma produced on its surface using an intense and short laser pulse.

LIBS offers several advantages over other analytical techniques, making it a valuable tool in a wide range of applications. LIBS requires minimal to no sample preparation. It can analyse a broad range of materials and detect all the elements in the periodic table. Using high repetition rates of the laser, it can perform real-time analysis which is useful for monitoring applications. At last, it can also operate in different atmospheric conditions.

Ultrashort laser pulses are currently being explored as a promising tool to enhance the capabilities of LIBS for precise elemental analysis, compared to conventional nanosecond lasers. These femtosecond or picosecond pulses reduce the thermal effects on the sample, offering minimal sample damage, reduced variability between pulses, improved spatial resolution and can also increase signal-to-background ratio.

The objective of my project is to develop a system for determining the atomic composition of various materials using LIBS technique. My main contribution will focus on investigating the use of ultrashort laser pulses to improve signal analysis, while finding the optimal experimental conditions. In a second step, I will also optimize the design of a spectrometer using the ray tracing software, Zemax. The system will be designed to enable rapid analysis, chemical mapping, and be competitive in terms of price and compactness for commercial applications.

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