



LIBS Analysis of Oils: A Spin-Coating Approach for High Sensitivity and Matrix Effect Suppression

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We present a methodology for the preparation and elemental analysis of oil samples using Laser-Induced Breakdown Spectroscopy (LIBS), designed to reduce matrix effects and sample volume while improving sensitivity and repeatability. The sample preparation involves stabilizing both the oil and a silica wafer substrate at a fixed temperature of 40 °C, followed by deposition of an oil droplet on substrate rotated by a spin coater, thus producing uniform thin films with tunable thickness governed by rotation speed [1].

This approach enables consistent sampling, independent of the oil's kinematic viscosity, and ensures a reproducible interaction volume for LIBS. Comparative measurements on pure oil and oil samples containing various elements revealed that matrix effect is significantly mitigated in thin oil films. For ultra-thin layers (~0.74 μm), the LIBS signal – particularly the carbon line – becomes stable and insensitive to impurity concentration, a key indicator of minimized matrix interference. Furthermore, pulse-to-pulse stability and electron density were significantly enhanced compared to bulk liquid targets, due to better plasma confinement [2].

Despite the minimal ablation volume (~0.3 nL per pulse), strong plasma emission was achieved. Using optimized delay times and line-specific calibration, we attained detection limits as low as 3.9 ppm for Zn, 0.49 ppm for Cd, 0.16 ppm for Cu, and 0.082 ppm for Cr. This method provides a highly sensitive and efficient pathway for trace elemental analysis in oil-based matrices [1].

References:

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