Discrimination of technical polymers via laser and electric spark discharge based optical emission

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Spark Optical Emission Spectroscopy (spark OES) and Laser-Induced Breakdown Spectroscopy (LIBS) are advanced element analysis methods that are widely used in the metal industry (spark OES) and in many different industry branches (LIBS [1]). While spark OES requires samples that are electrically conductive, LIBS can be employed to nearly all kinds of materials. However, LIBS is suffering from the matrix effect, i.e. the sensitivity and limits of detection depend on the structure and composition of the sample matrix. We combine electric spark discharge and laser ablation for the excitation of analytical plasma and optical emission spectroscopy (Laser Ablation Spark Discharge OES, LA-SD-OES). This combination has been shown to overcome the matrix effect for high alloyed steel samples [2]. Here, we report on further advancements of the LA-SD-OES method to measure also non-conductive samples. A low-to-mid energy laser pulse is applied to the sample inducing a faint plasma that triggers an electric spark discharge between two electrodes. The optical emission of the laser-induced/spark plasma is measured.

Different technical polymers (PA6, PC, PE-HD, PET, PMMA, POM, PP, PS, PTFE, PVC, UHMWPE, etc.) are measured by LIBS and LA-SD-OES aiming to distinguish the materials by distinct spectral features. Molecular emission bands of CN and C_2 as well as atomic lines of O, N, H, and of some specific elements are measured and the correlation of intensities is used for materials discrimination. Halogenation of polymers as well as signs for flame retardants etc. can be easily detected with LA-SD-OES while LIBS is not able to identify these additives. The damage of the polymer sample surfaces stays minimal as the electric spark discharge does not contribute to the ablation process.

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