Identification and sorting of materials with portable LIBS before decommissioning

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Laser Induced Breakdown Spectroscopy (LIBS) is a technique of elemental analysis. A laser beam is focused on the surface of the sample to be analyzed. A small quantity of matter is ablated and a plasma formed by the atomized compounds is created. The spectral lines of the light emitted by the plasma are detected by an optical spectrometer. LIBS is a fully optical, multi-elementary and fast analytical technique, requiring no or little sample preparation. These features make the LIBS technique particularly suited for in situ measurements, and portable instruments are currently developed.

LIBS analysis can be applied to the identification of materials using chemometric statistical methods (multivariate analysis) connecting the spectrum to the nature of the sample. Such methods have been successfully applied in our laboratory to the determination of the geographical origin of yellow cakes [1] and to the identification of alloys. We present here the work performed with a portable LIBS instrument to meet the needs of waste sorting in industrial domain and in nuclear domain (inventory before decommissioning). A data base of LIBS spectra was built with a commercial instrument (IVEA SAS Easylibs) with samples of four categories of interest for industrial waste sorting: alloys, plastics, concrete and glasses.

Figure 1: Easylibs portable instrument (courtesy of IVEA)

Different correct identification rates are requested by categories. The alloy spectra contain characteristic spectral lines and sub-categories can be easily discriminated (for example, different steel classes can be identified). The components of the plastics (mainly C, H, O and N) give rise to less characteristic lines and the plastics identification requires a separate study. Supervised statistical models are built with the data base spectra and predictions are instantly calculated for the spectra of unknown materials to identify in order to direct them to the correct waste stream.

References

[1] J.-B. Sirven, A. Pailloux, Y. M'Baye, N. Coulon, T. Alpettaz, S. Gossé. "Towards the determination of the geographical origin of yellow cake sample by laser-induced breakdown spectroscopy and chemometrics". J. Anal. At. Spectrom. 24, 451-459, 2009.