



HAND-GUIDED DIRECT ANALYSIS OF METAL

Task

In recycling and in quality control, chemical analyses are becoming increasingly important, and more and more hand-held systems are being used to conduct measurements on site. Currently used, spark discharge spectrometers or X-ray fluorescence analysers require an extensive cleaning of the sample and exhibit measurement durations of over 15 seconds. For laser direct analysis, preparation and measurement are combined in one process so that a significantly higher throughput is reached. The goal here is the development of a process and the set-up of a demonstration model for mobile laser direct analysis of metal pieces with a hand-guided measurement probe.

Method

Investigations with a fiber laser demonstrate that it can generate sufficiently strongly emitting laser-induced plasma on metal workpieces due to its high repetition rate, in spite of the small pulse energy. For spectral analysis, the signal of several single micro plasmas is integrated on the detector chip. The process parameters – as, e.g., pulse-to-pulse signal stability and gas exchange – were investigated experimentally to optimize the system's measuring accuracy.

Jointly with the project partners, Fraunhofer ILT has developed a demonstrator model, consisting of a freely movable measurement probe, which can be guided by hand, a fiber-optical interconnector and a base unit. The demonstrator model was tested in the field at recycling companies and compared with the state-of-the-art systems to evaluate its precision and throughput.

Result

The analytical comparison with conventional processes shows similar and, in part, better precision for the identification of element concentrations in steel and aluminum alloys. The total measurement duration, at approximately one second, lies more than one order of magnitude below that of conventional systems.

Applications

In addition to various metals, such as steel, aluminum or titanium, other solid materials such as minerals or glass can be analyzed. The measurement probe can be integrated into a robot arm so that automated tests can also be conducted.

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3 Demonstrator model.

4 Hand-guided measurement probe for laser-based direct analysis.