# Energy-optimized Production of Secondary Aluminum through Inline Analytics (LIBS)

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## Abstract

Aluminum plays a key role in current developments toward closed raw material cycles. The production of primary aluminum from bauxite is known to be very energy-intensive. However, when using secondary aluminum, the energy input is reduced to only 5-10% compared to the production of primary aluminum.

It is crucial for closed raw material cycles to recycle raw materials of the same quality in order to avoid downcycling. For such precision recycling, sensor-based sorting with a sensor that can determine the elemental composition of aluminum alloys is key. However, existing methods such as X-ray fluorescence (XRF) only detect heavy alloying elements such as copper and zinc, but not the lighter but important alloying elements such as magnesium and silicon.

*Laser-induced breakdown spectroscopy (LIBS)* allows accurate analysis of all elements in aluminum alloys. The material under investigation is irradiated with a laser pulse of high energy density. This creates a plasma whose elemental fingerprint can be analyzed in less than a millisecond. Multifraction recycling systems for high-purity fractions can be realized on the basis of LIBS. The generated fractions can be used directly in the remelting process.

In today's remelting processes, the manually or automatically taken samples are analyzed in the laboratory. Only when the results are available can deviations between the target alloy and the existing composition be reacted to. This time delay ties up production capacities and wastes considerable amounts of energy. This is where LIBS can be used in an inline measurement process and analyze the composition directly in the process without time delay.

In this presentation, the basics of LIBS will be discussed, the advantages of inline measurement technology compared to offline methods will be shown and the applications "aluminum recycling" and "liquid aluminum analysis" will be presented.