WASTE SORTING BY LASER INDUCED BREAKDOWN SPECTROSCOPY

M.ª Inês Costa, Luís Fonseca, Sophie Hoppenz, João Lisboa, Alba Perez
[1]Department of Materials and Production, Aalborg University
Fibigerstraede 16, DK-9220 Aalborg East, Denmark
Email: {aperez21, jlisbo21, ldeoli21, mcosta21, shoppe21}@student.aau.dk,
web page: http://www.mechman.mp.aau.dk/

Keywords: LIBS, Waste sorting, Polymers, Nanosecond Laser, Plasma, Atomic Spectra

ABSTRACT

The demand for polymer products is constantly rising. Polymer production is predicted to increase to 1200 million tons by 2050. Without efficiently recycling these polymers, this will result in economic losses and pose a significant thread to the environment [1]. Most recycling processes require pure polymers, which makes it necessary to develop a fast and efficient sorting system [2].
Different methods are used for the sorting of polymer waste. Many of them, such as manual sorting, are very time consuming. Others, such as atomic absorption spectroscopy, require complicated sample preparation. Laser induced breakdown spectroscopy (LIBS) solves both of these problems. It presents a reliable, fast, and compact alternative to commonly used waste sorting strategies [3].
The aim of this project is to design a system which utilizes LIBS to identify and sort several different types of polymers, and that is applicable from tabletop to large industrial systems. The system will be optimized to make it as cheap and fast as possible while obtaining the most reliable results.

LIBS uses a laser pulse, which is sent to a sample, where it breaks down the atomic structure and vaporizes part of it. The vapor absorbs more energy, and its components are ionized, creating a plasma. After the pulse ends, the plasma starts to cool down and the electrons return to their natural ground states emitting light with discrete spectral peaks. This light will then be collected by a spectrometer to be analysed and information about the composition of the sample can be obtained from said peaks [4,5].

The laser used for this project is a pulsed nanosecond Nd:YAG laser generating light at 1064nm. Protocols for automatic fast identification of polymers from LIBS spectra will be developed.

Acknowledgement

The authors of this work gratefully acknowledge Grundfos for sponsoring the 10th MechMan symposium.

REFERENCES

[1] Sibao et.al. Plastic waste to fuels by hydrocracking at mild conditions. *Science Advances, Vol. 7, Issue 17 (2021).* DOI: 10.1126/sciadv.abf8283

[2] Araujo-Andrade C. et.al. Review on the photonic techniques suitable for automatic monitoring of the composition of multi-materials wastes in view of their posterior recycling. *Waste Management & Research. 2021;39(5):631-651.* DOI:10.1177/0734242X21997908

[3] Ke Liu et.al. A review of laser-induced breakdown spectroscopy for plastic analysis, *TrAC Trends in Analytical Chemistry, Volume 110, 2019, Pages 327-334,* DOI:10.1016/j.trac.2018.11.025.

[4] Mputu Kanyinda Jean-Noëla et. Al. LIBS technology and its application: overview of the different research areas. *Journal of Environmental Science and Public Health 4 (2020): 134-149* DOI:10.26502/jesph.96120090

[5] Pasquini, Celio et. al. Laser Induced Breakdown Spectroscopy. *J. Braz. Chem. Soc. 18. 463-512, 2007* DOI:10.1590/S0103-50532007000300002.