

## Pushbroom imaging based on laser-induced fluorescence spectroscopy for fast powder analysis

Christoph Kölbl,<sup>1</sup> Jonas Grzesiak,<sup>1</sup> Manuel Diedrich,<sup>1</sup> Frank Duschek<sup>1</sup>

<sup>1</sup>German Aerospace Center, Institute of Technical Physics, 74239 Hardthausen, Germany

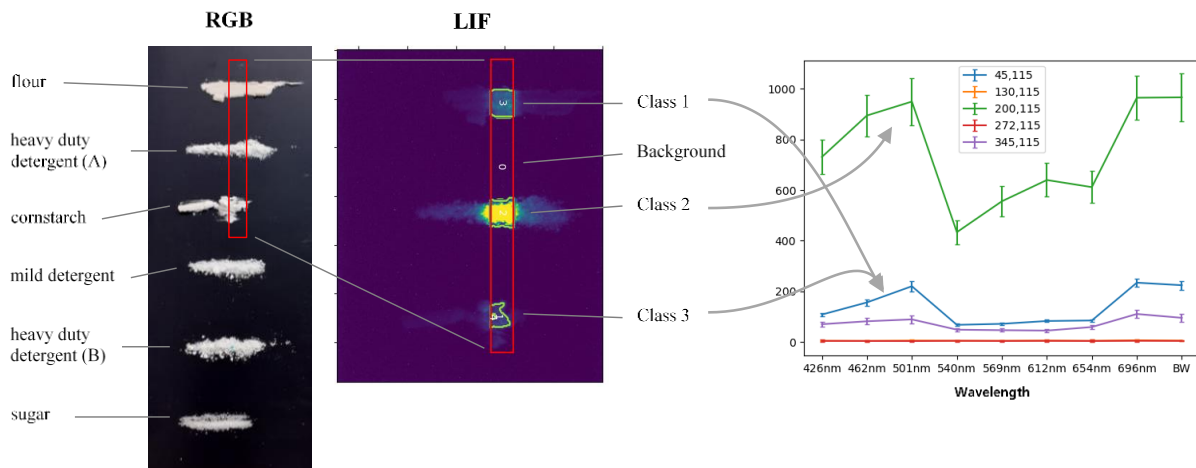
christoph.koelbl@dlr.de

Letter bombs sent via the postal service are designed with the intention to injure or kill the recipient when opened<sup>1</sup>. A related threat is mail containing unidentified powders or chemicals<sup>2,3,4</sup>, like the anthrax<sup>5</sup> or ricin<sup>6</sup> attacks. A fast reconnaissance can prevent human contact to such hazardous, often unknown CBE materials from intended and accidental release.

That's why the DLR Institute of Technical Physics develops suitable methods and instruments – mainly based on laser spectroscopic techniques – to detect threats and evaluate them for being able to take appropriate countermeasures.

For remote analysis of unknown powders, we have developed a laboratory setup based on laser-induced fluorescence spectroscopy. By fanning out the laser beam to a laser line in one direction and scanning the sample with a motorized stage along the second axis, perpendicular to the laser line, this specific system is capable of performing laser-induced fluorescence pushbroom-imaging on pure powder samples.

Within the context of the CBRNe protection symposium, we present experimental results acquired during our laboratory tests. These measurements confirm the feasibility of a fast, flexible remote detection of CBE traces.



**Fig. 1:** Left: Different powder samples measured with the setup. The indicated red area shows the spanning of the laser beam which is used for laser-induced fluorescence (LIF) spectroscopy. Right: Corresponding LIF-image after data-analysis with assigned powder test-classes.

<sup>1</sup> DW: Germany: 3 injured in mail bomb blast at Lidl HQ; <https://www.dw.com/en/germany-3-injured-in-mail-bomb-blast-at-lidl-hq/a-56603789>; 2021

<sup>2</sup> The Canberra Times: Police investigate suspicious package at Russian Embassy; <https://www.canberratimes.com.au/story/7644565/police-investigating-powder-left-at-russian-embassy/>; 2022

<sup>3</sup> WDR: Pulver in Brief löst Großinsatz aus; <https://www1.wdr.de/nachrichten/westfalen-lippe/iserlohn-letmathe-pulver-brief-100.html>; 2021

<sup>4</sup> Strudel: Police are investigating: mystery of powder letters in Unna; <https://strudel.com/police-are-investigating-mystery-of-powder-letters-in-unna>; 2021

<sup>5</sup> The United States Department of Justice: Amerithrax Investigative Summary; <https://www.justice.gov/archive/amerithrax/docs/amx-investigative-summary.pdf>; 2010

<sup>6</sup> FBI National Press Office: Ricin Letter; <https://archives.fbi.gov/archives/news/pressrel/press-releases/ricin-letter>; 2004