

# Development of a calibration strategy for LA-ICP-MS based on dried residues of individual picoliter droplets

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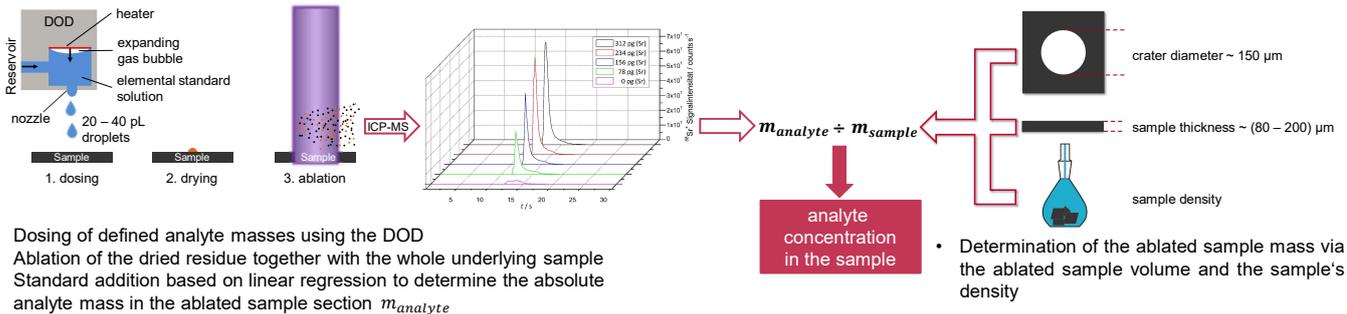
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Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) is an important technique for direct spatially resolved elemental analysis of solid samples. Matrix matched standards have to be used for external calibration of LA-ICP-MS due to elemental fractionation and matrix effects. There is only a limited number of certified reference materials available, that might be suitable to serve this goal. As standard addition is a matrix independent approach without the need for matrix matched standards, it is well suited for calibration of LA-ICP-MS. It was shown that standard addition based on residues of dried aqueous elemental standard solutions works well for quantitative LA-ICP-MS analysis of different materials such as glass<sup>[1]</sup> and polymers<sup>[2]</sup>. A drop-on-demand (DOD) dosing device based on thermal inkjet technology was developed to deposit single pL-droplets of elemental standard solutions on solid samples.<sup>[3–5]</sup> These residues are suitable for quantitative spatially resolved LA-ICP-MS analysis of thin layered materials e.g. electrical tapes. Such tapes are common tools for criminal acts like the construction of improvised explosive devices and can therefore be used as evidence.<sup>[6]</sup>

## 1. Principle



## 2. Experimental Setup

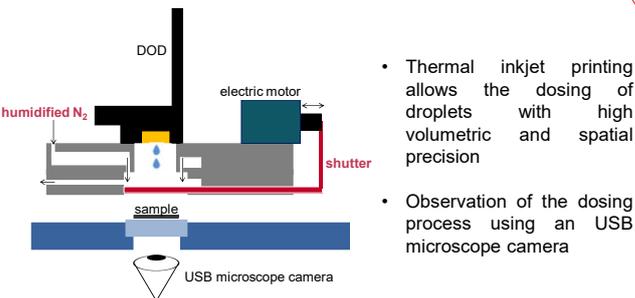


Fig. 1: Interface with integrated shutter and gas supply for humidified nitrogen.<sup>[7]</sup>

- Humidified nitrogen prevents preconcentration of the solution inside the nozzle chamber
- The shutter allows to discard the first droplets of a cascade of dosing events, which differ regarding their size and the transferred analyte mass from subsequent droplets

## 3. Dosing Precision

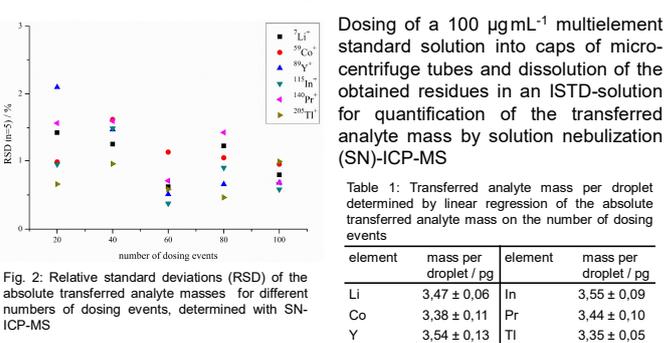


Fig. 2: Relative standard deviations (RSD) of the absolute transferred analyte masses for different numbers of dosing events, determined with SN-ICP-MS

## 4. Proof of Principle

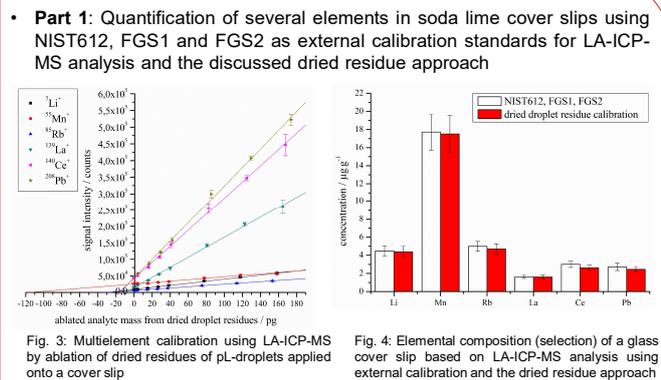


Fig. 3: Multielement calibration using LA-ICP-MS by ablation of dried residues of pL-droplets applied onto a cover slip

Fig. 4: Elemental composition (selection) of a glass cover slip based on LA-ICP-MS analysis using external calibration and the dried residue approach

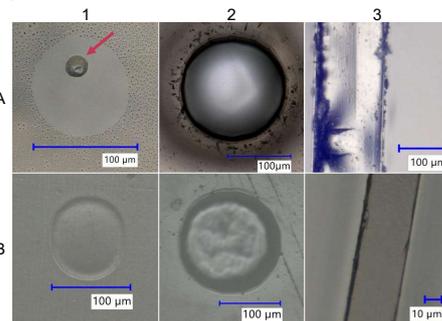


Fig. 5: 1. Residues of four subsequent dosing events. 2. Ablation craters. 3. Photography of sample edges. A: cover slip, B: polymeric thin section

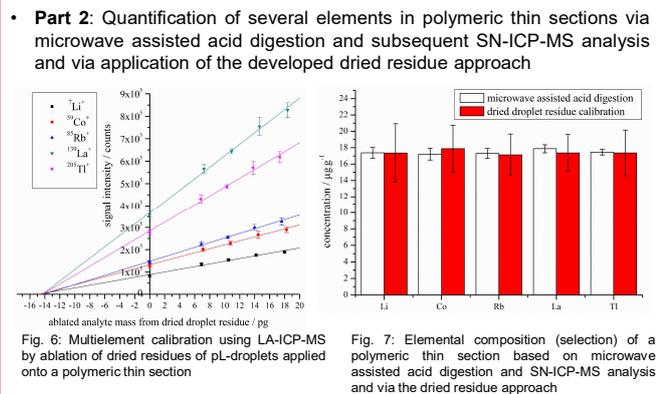


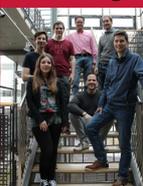
Fig. 6: Multielement calibration using LA-ICP-MS by ablation of dried residues of pL-droplets applied onto a polymeric thin section

Fig. 7: Elemental composition (selection) of a polymeric thin section based on microwave assisted acid digestion and SN-ICP-MS analysis and via the dried residue approach

## Conclusion & Outlook

- Precise dosing of pL-droplets allows the application of a matrix independent dried residue approach to various thin layered materials
- Application of the developed dried residue approach to real samples (e.g. PVC tapes)

AK Bings



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