Flexible and reusable parylene C masks technology for applications in cascade impactor air quality monitoring systems

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Introduction and Motivation

Nowadays **air pollution**, that come from both anthropogenic and natural sources, is the leading cause of environmentally related severe health effects and climate change concerns [1]. Inhalable **aerosol particles** are the largest contributors. In the metrological framework, an important challenge that has to be tacked urgently is the **development of certified reference substrates** and traceable measurements techniques for quantification of regulated and unregulated substances. In this way, it is possible to add value to the use of **cascade impactor sampling coupled with** Total Reflection X-Ray Fluorescence **(TXRF) spectroscopy** for element mass concentration measurements in ambient air in an accurate way with fast response and low level of uncertainty [1-2].
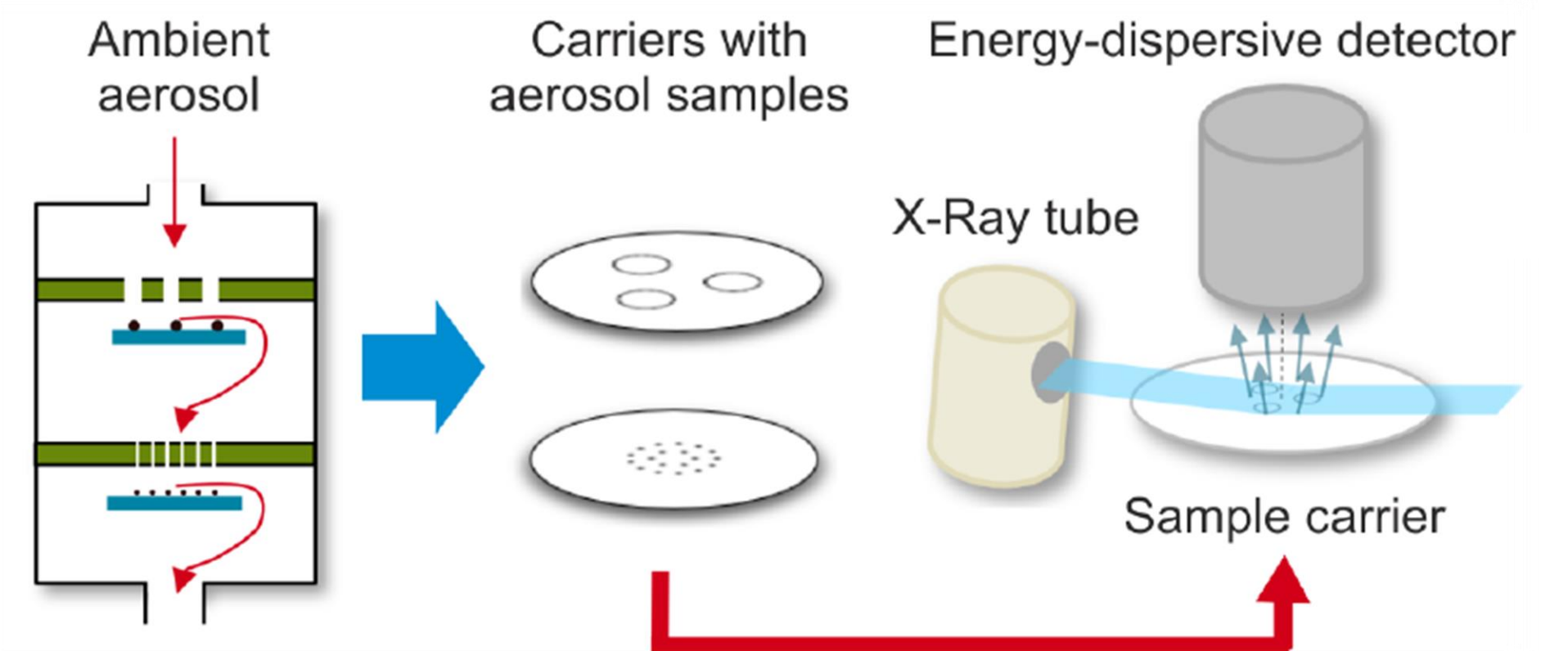
Problem

Lack of traceable standards and harmonized calibration procedures for measuring aerosol particles.

Strategy

Development of **flexible, reusable and low-cost parylene C shadow masks** for reference samples **micropatterning**.
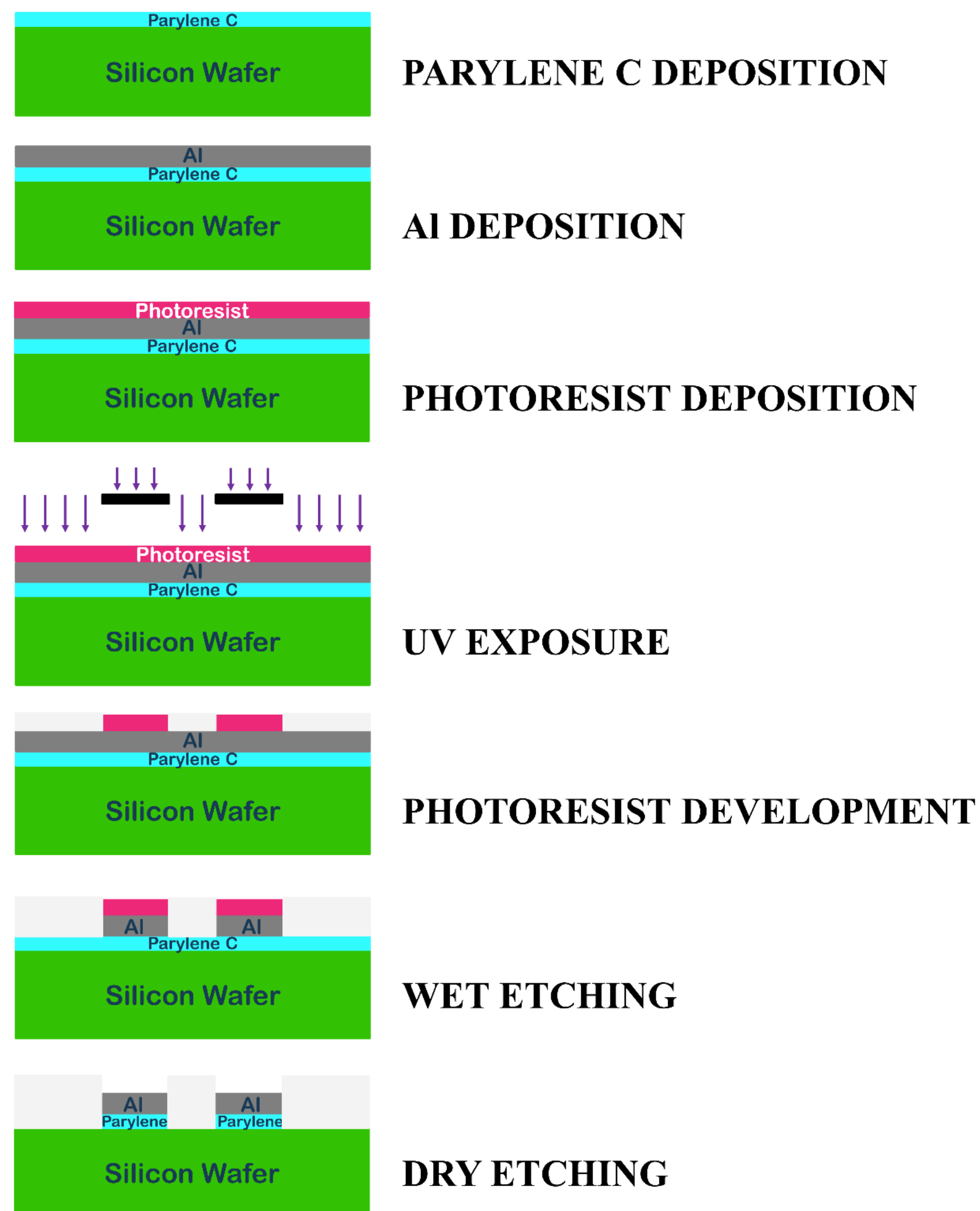
Objective

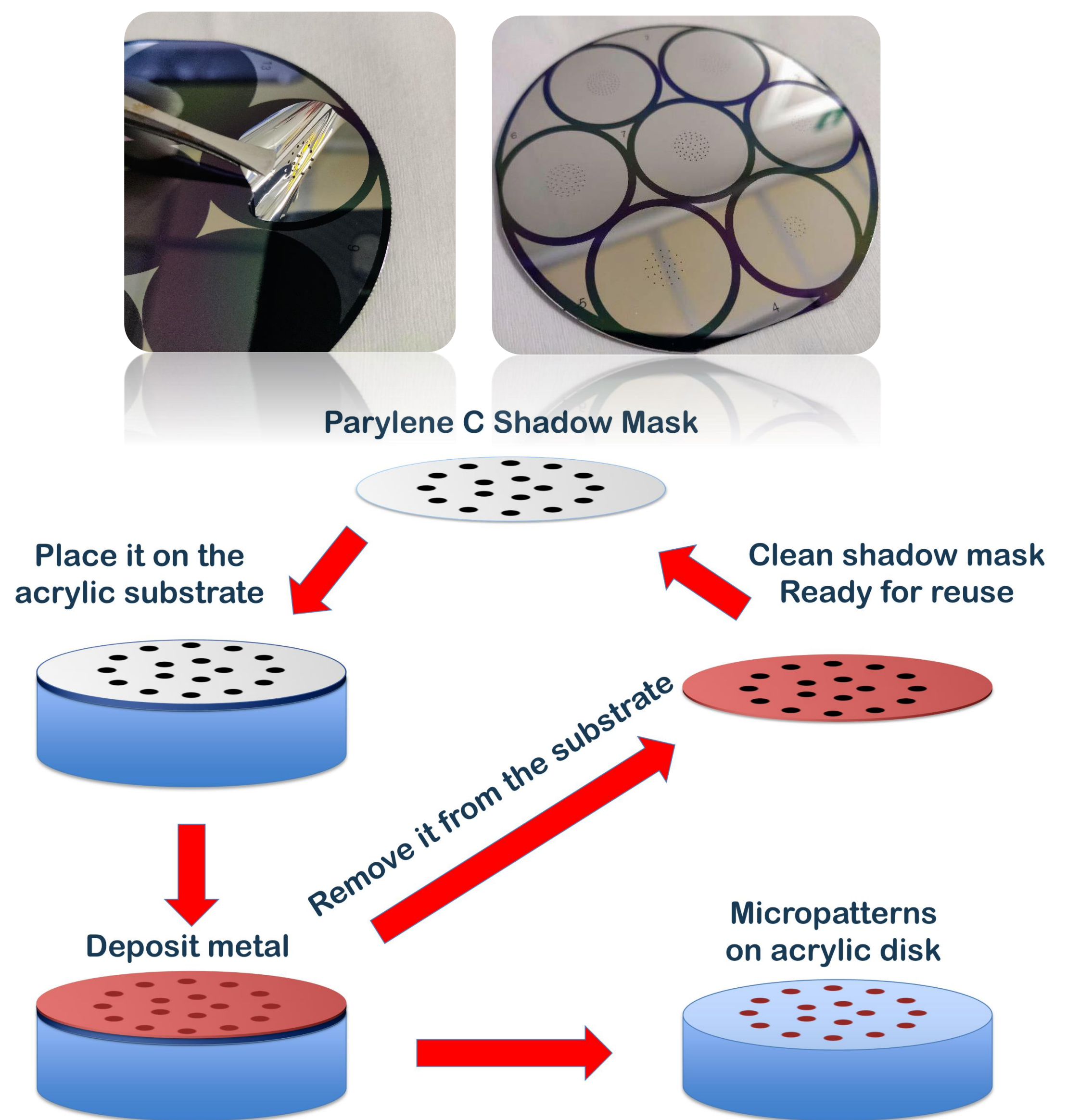**Design and produce set of reference samples** mimicking deposition patterns of cascade impactors such as the Dekati DLPI 10.

Experimental Work and Results

Parylene C Shadow Masks fabrication

PARYLENE C DEPOSITION

Al DEPOSITION

PHOTORESIST DEPOSITION

UV EXPOSURE

PHOTORESIST DEVELOPMENT

WET ETCHING

DRY ETCHING

Micropatterning of Reference Samples

Parylene C Shadow Mask

Place it on the acrylic substrate

Clean shadow mask Ready for reuse

Remove it from the substrate

Deposit metal

Micropatterns on acrylic disk

Conclusions

- Reference samples with different cascade impactor stages patterns were successfully realized with this technique.
- Highly flexible direct patterning of acrylic substrates otherwise impossible with conventional photolithography procedures.
- Parylene C micro-stencils were successfully reused multiple times without any damage or contamination.
- Good accuracy achieved on features down to 250 µm with an error less then 4%.
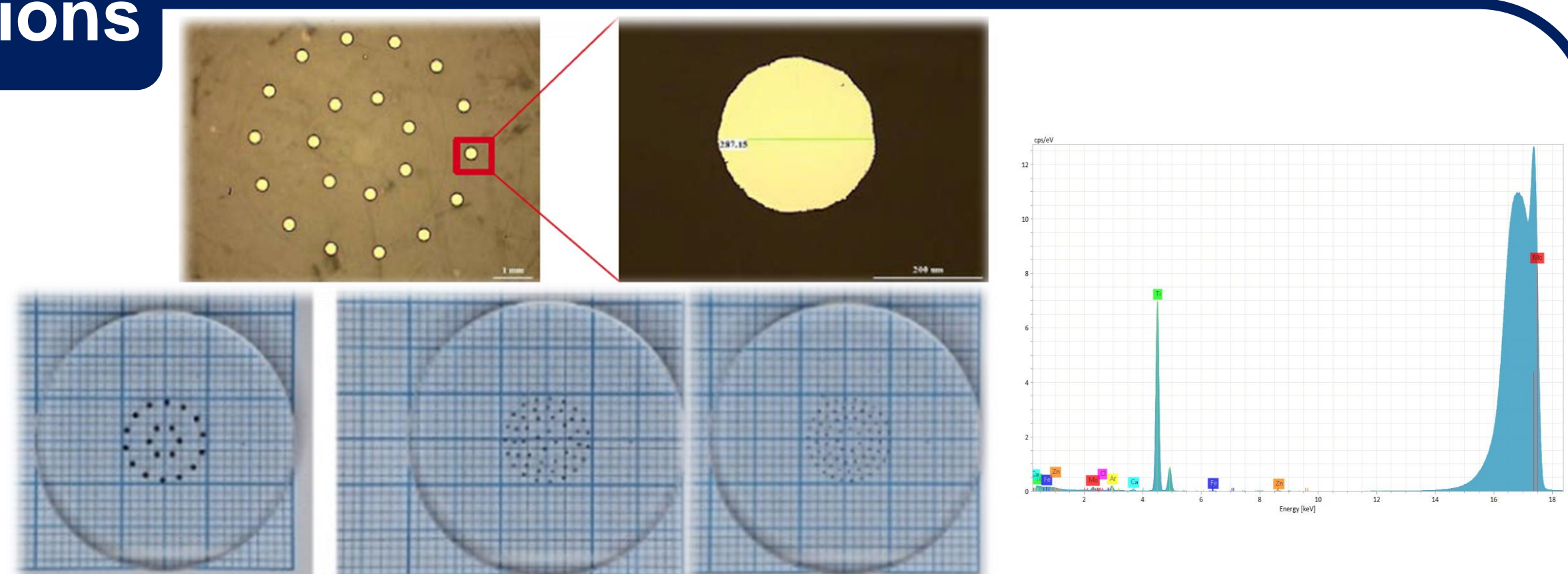
[1] S. Seeger et al., Quantification of element mass concentrations in ambient aerosols by combination of cascade impactor sampling vigna and mobile total reflection x-ray fluorescence spectroscopy, Atmosphere. 12 (2021). https://doi.org/10.3390/atmos12030309
[2] S. Selvarasah et al., A reusable high aspect ratio parylene-C shadow mask technology for diverse micropatterning applications, Sensors Actuators, A Phys. 145–146 (2008) 306–315. https://doi.org/10.1016/j.sna.2007.10.053.