SAMPLE COLLECTION WITH EMILIE™

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July 17, 2026

1 INTRODUCTION

Sample preparation and introduction is always a main concern with any analytical technique. The EMILIE™ NEMS-FTIR technique is unique in that its central part - the nanomechanical chip - is used both as a sample holder and as a sample detector. Sample deposition directly on the sensing element allows for the extremely high sensitivity of the technique.

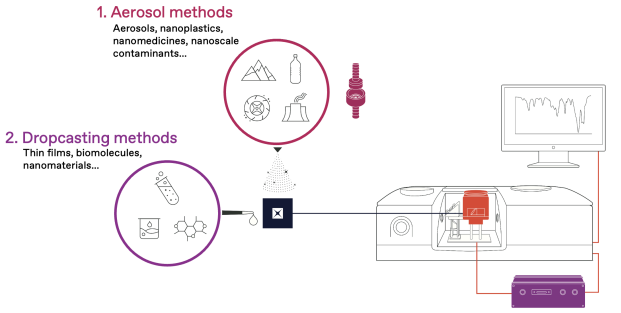


Figure 1: Sample deposition on the EMILIE™ chip. Analyte can be collected on the EMILIE™ chip either by aerosol sampling or drop casting.

2 SAMPLE COLLECTION STRATEGIES

Several strategies are available to deposit samples at the surface of the EMILIE™ chip. Samples can be deposited on the EMILIE™ chip by aerosol or drop-casting techniques as shown in Fig.1. It is to be noted that because measurements are performed in vacuum, only non-volatile and semi-volatile analytes can be analyzed with EMILIE™. The EMILIE™ chip is made of a chemically and heat-resistant silicon nitride ceramic. The important factors to consider when elaborating a sampling strategy are:

- The EMILIE™ chip should not be overloaded with sample. The maximal sample amount, depending on the analyte, is a few hundred nanograms.
- Procedures that may harm the mechanical integrity of the membrane at the center of the EMILIE™ chip should be avoided.
- Procedures that may affect the tensile stress of the EMILIE™ chip should be avoided.

The sample collection strategy depends on the form of the analyte. It is possible to deposit analytes in various forms, including aerosol, powder, dispersion, or solution, on the EMILIE™ chip.

- **Aerosol (particle size from 10 nm to 3200 nm):** Can be collected directly by the aerosol method. See section 2.1.
- **Powder:** Can be aerosolized and collected by the aerosol method (see section 2.1) or dispersed in a liquid and drop cast (see section 2.2), respectively.
- **Dispersion:** Can be nebulized and collected by the aerosol method (see section 2.1) or drop casted (see section 2.2) directly.
- **Solution:** Can be nebulized and collected by the aerosol method (see section 2.1), or drop casted (see section 2.2) directly.

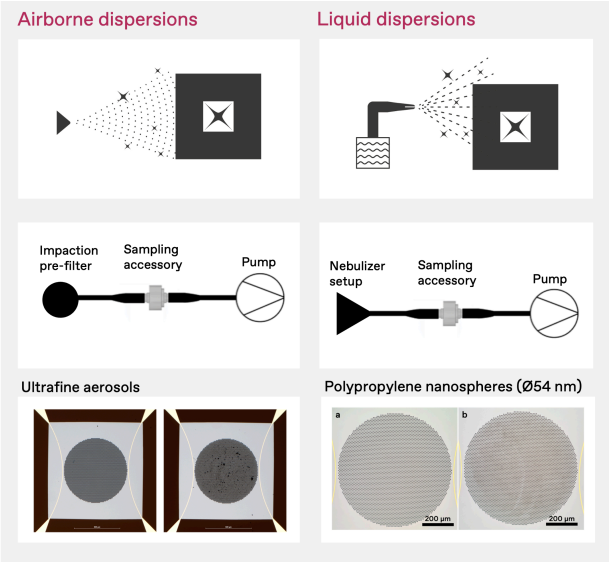


Figure 2: Analytes can be collected directly on the EMILIE™ chip using aerosol methods. This sampling strategy applies to natural aerosols (airborne dispersions) or nebulized liquid dispersions, solutions, and powders.

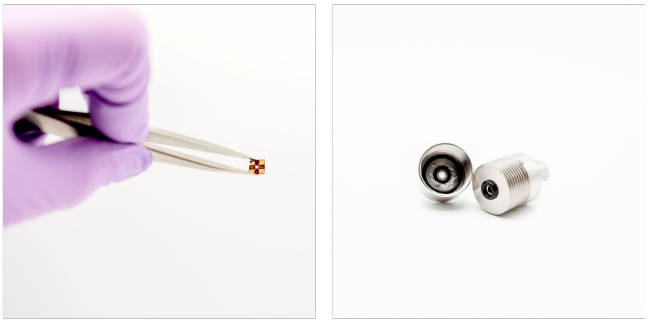


Figure 3: The EMILIE™ chip (left) can be placed in the Aerosol Flow Adapter (right) for easy and seamless interfacing with common aerosol collection and nebulization equipment.

2.1 Aerosol method

An efficient way for sampling airborne nanoparticles is to collect them directly from an aerosol onto the EMILIE™ chip. An overview of the aerosol sampling method is presented in Figure 2. In this method, the aerosol is aspirated through the EMILIE™ chip. The airborne nanoparticles are then collected on the EMILIE™ chip through an impaction process with a high efficiency of up to 60%. The Aerosol Flow Adapter, illustrated in Fig. 3, facilitates easy interfacing of the EMILIE™ chip with standard aerosol sampling apparatus. This method works for airborne nanoparticles with a size as low as 10 to approximately 1500 nanometers.

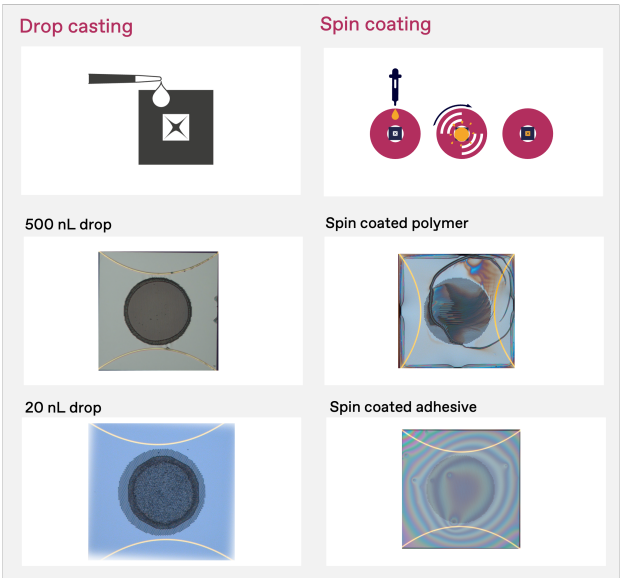


Figure 4: Semi-volatile and non-volatile analytes are easily deposited on the EMILIE™ chip via drop casting. Further treatment such as spin coating can be further applied for samples such as polymers and adhesives.

When sampling from a liquid dispersion or a solution, the Aerosol Flow Adapter can be seamlessly interfaced with a nebulizer and spray chamber apparatus, similar to those commonly used in elemental spectroscopy methods. Powder samples can be aerosolized through methods commonly used, e.g., in medical inhalers.

2.2 Drop casting method

Various types of semi-volatile and non-volatile samples can be collected on the EMILIE™ chip using straightforward drop casting methods, as illustrated in Figure 4. These methods include drop casting with a pipette or nanodrop dispensing with a nanolitre droplet dispenser. For drop casting, Invisible-Light Labs offers a dedicated Drop Casting Accessory that ensures all the sample is collected at the center of the sensor chip, facilitating quantitative analysis. Additionally, it is possible to spin coat the drop cast solution to produce a thin film for analysis.

3 CONCLUSION

The possibilities for depositing samples on the EMILIE™ chip are diverse and can be adapted to your needs. Contact us at info@invisible-light-labs.com to discuss sampling with EMILIE™ of your specific analyte.