

Medical

RS DYNAMICS[®]
Science for Safety and Health

AirOnics

Continuous Offline Breath Sampler
with Highly Enriched Liquefied Output

AirOnics[®] collects and concentrates exhaled breath samples into an organic solvent mixture that is stable and ready for analysis.

Key Benefits:

- Non-invasive exhaled breath sample collection
- Ultra-trace sample enrichment - up to 100 000
- Continuous collection procedure without interruption
- Direct compatibility with MS-based analytical platforms
- Broad variability setup allowing different analytical approaches



Patent pending

AirOnics[®] achieves these unique performance parameters through a three-step process:

1. Intelligent, CO₂-Gated Sampling:

The patient exhales into a single-use, contamination-free inlet. An integrated CO₂ sensor precisely gates the collection, ensuring only the most valuable, deep-lung air (alveolar breath) is sampled. This intelligent triggering maximizes the capture of endogenous metabolic biomarkers while discarding inert dead-space air.

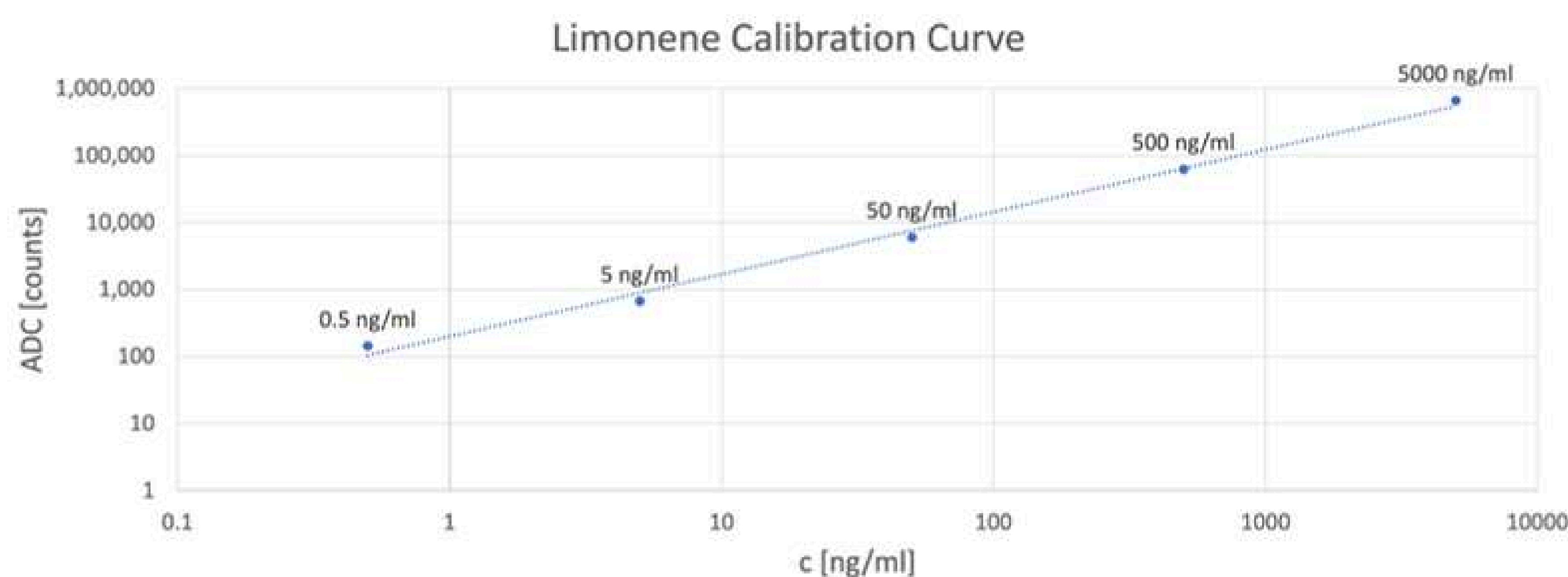
2. Aerosolization and Enrichment:

The captured breath is directed into a temperature-controlled, heated reaction chamber. Here, it is mixed with a micro-sprayed organic solvent, creating a fine aerosol. This process efficiently transfers volatile organic compounds (VOCs) and other biomarkers from the gaseous phase into the solvent droplets.

3. Condensation and Pre-Concentration:

The aerosol is then passed through a second, cooled thermal zone. This temperature drop induces condensation, converting the aerosol back into a liquid. This phase change dramatically reduces the sample volume, resulting in a final, stable 1 mL liquid sample where the biomarkers are concentrated by a factor of up to 100,000.

Analysis



Results

Samples are collected by the AirOnics[®] exclusively from the end-tidal expiratory phase (ETEP), which is identified by a CO₂ sensor based on the carbon dioxide concentration in the exhaled breath. The highly enriched liquefied sample obtained from exhalation procedure is collected and stored in a vial, ready for mass spectrometry (MS) or other analytical techniques.

AirOnics[®] is capable of collecting trace amounts of chemical compounds from breath samples at concentrations as low as the ppt (parts-per-trillion) level as well as particles in respiratory breath, including of bacteria and viruses.

The AirOnics[®] sampling process can be repeated without limitations in time or sampling capacity.

Constructed entirely from inert materials, AirOnics[®] prevents the degradation of collected chemical compounds.

AirOnics[®] is compatible with a variety of absorbent solvents, depending on the target volatile organic compounds (VOCs).

If a nonpolar liquid, such as n-heptane, is used as the absorption liquid, two phases will form in the stored vial: the upper phase is n-heptane, and the lower phase is aqueous, which contains most of the polar compounds absorbed into it. If the absorbent liquid is miscible with water such as ethanol we obtain a homogeneous liquid sample that can be directly analyzed using various analytical techniques.

Principle explained

In general the AirOnics[®] works as a mass exchanger with continuous contact of phases (gas and liquid) where mass transfer occurs in the whole volume of apparatus. The intensity of analyte mass transfer $\langle j_{An} \rangle_{\tau}$ of in gas phase compounds to liquid phase can be described by the relationship:

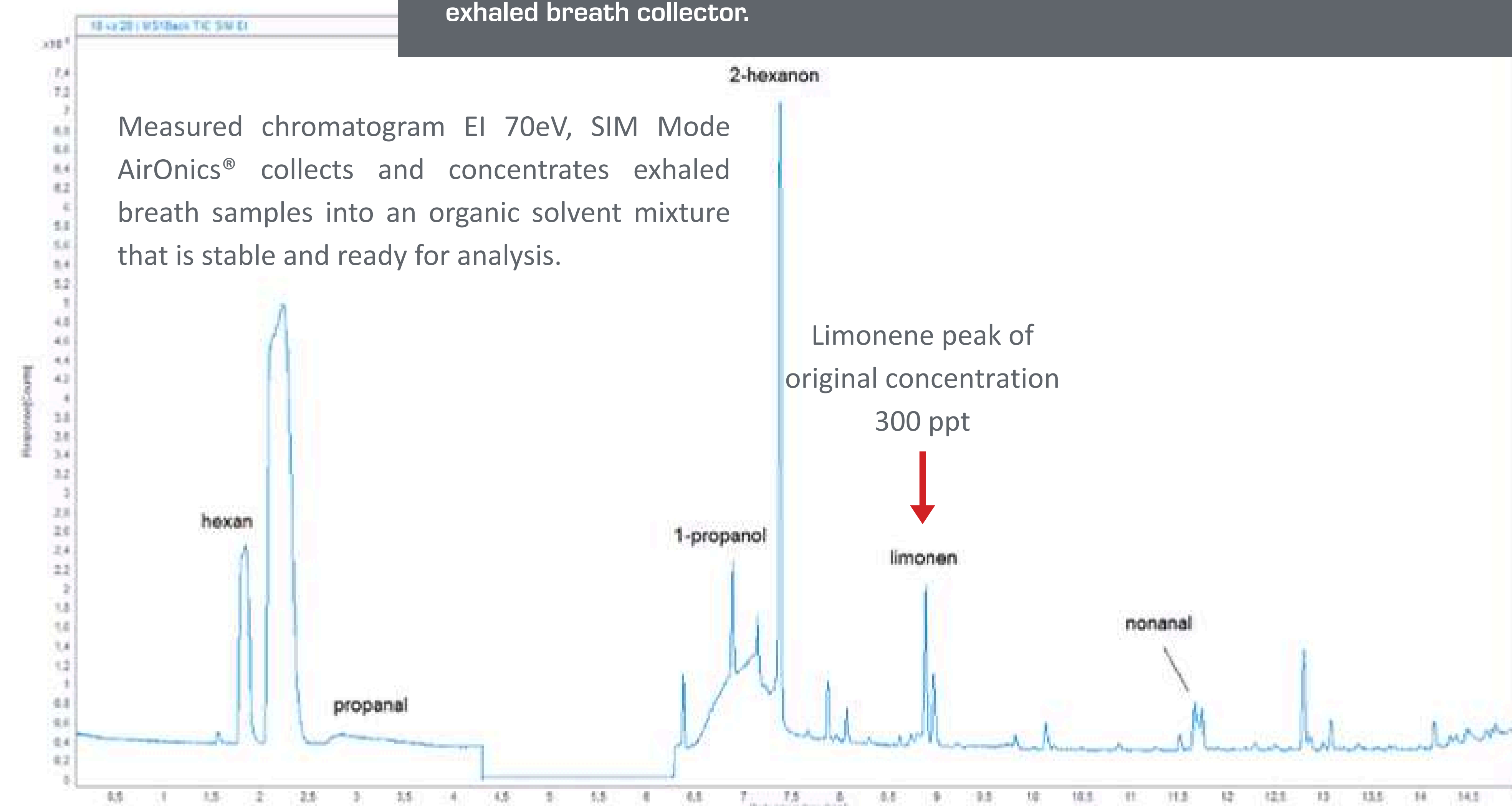
$$\langle j_{An} \rangle_{\tau} = -[J_D - J_T] \quad \langle j_{An} \rangle_{\tau} = -\left[\frac{\rho D_A}{d \langle X_A \rangle_{\tau}} - \rho \langle X_A V_n^* \rangle_{\tau} \right]$$

where V_n^* denotes the fluctuation of a mixture weighed according to the mass amount, D_A is the diffusion coefficient of analyte, ρ is the density of the medium, X_A is the analyte concentration in the gas phase and $\frac{d \langle X_A \rangle_{\tau}}{dn}$ is the analyte concentration gradient. In case of the enrichment by means of the balanced aerosol accumulation the turbulent component of the mass flow J_T is the most important.

The following relationship describes the collection efficiency of the compounds of interest with of the balanced accumulation.

$$\frac{Q_{iL}}{Q_{iG}} = \frac{K_i \frac{U_L}{U_G}}{1 + K_i \frac{U_L}{U_G}}$$

Where K_i is the distribution constant of the analyte between the liquid and the gas phase, U_L and U_G are the liquid and gas phase volume flows, respectively, through the aerosol enrichment unit (AEU). Q_{iG} and Q_{iL} are the amount of VOC entering the AEU in the gas phase and the amount of VOC absorbed in the liquid mixture leaving the miniaturised exhaled breath collector.



AirOnics[®] collects and concentrates exhaled breath samples into an organic solvent mixture that is stable and ready for analysis.

Headquarters:

RS DYNAMICS LLC
Bleichstrasse 8
Postfach 7630
6302 Zug
Switzerland

Visitors:

RS DYNAMICS LLC
Technopark Zurich, 4th floor
Technoparkstrasse 1
8005 Zurich
Switzerland

Technical Support:

RS DYNAMICS s.r.o.
Starochodovská 1359/76
149 00 Prague
Czech Republic
European Union