

Advanced in vitro exposure systems

VITROCELL® Automated Exposure Station



VITROCELL® Automated Exposure Station

User friendly solution with high tech features

The VITROCELL® Automated Exposure Station has been specifically designed and engineered to facilitate the research of mammalian cell cultures in direct exposure to airborne substances such as gases, complex mixtures, nanoparticles and fibers. The system authentically simulates the conditions of human physiological exposure.

It offers a capacity of up to 18 cell culture compartments for exposure and 6 compartments for clean air control.

All key functions for successful exposure such as, aerosol flow rates, humidity, temperature and leak test are edited by touch-screen prior to the experiment. The respective data is shown on live graphs and stored for further analysis. The cells are exposed at the air/liquid interface on 6/12/24-well sized cell culture inserts.

The isokinetic sampling system enables a uniform and reproducible delivery of the test substance to the cells. Applying an electrical field increases deposition efficiency.

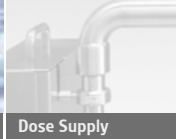
Post-exposure the cells are further processed to measure a wide range of endpoints, e.g. cytotoxicity, genotoxicity, proliferation, cellular and oxidative stress as well as inflammation. See also the VITROCELL® assay guide for further information.



Optional VITROCELL® 6/6 CF modules



Exposure Systems



Dose Supply



Dilution



Racks & Carts



Dose Monitoring



Skin Exposure



Auxiliary Equipment

VITROCELL® Automated Exposure Station

Standard Version



Automated Exposure Station for up to 4 VITROCELL® 6 modules (pictures showing version with 3 modules). For other exposure module options see page on available configurations.

Features

- Direct aerosol sampling
- Size selective inlet
- Automated process
- Temperature controlled system
- Integrated humidification of aerosol
- Aerosol flow control by mass flow controllers
- Touch-screen display
- Analytical modules for TEM evaluation
- Central data management system
- Online dose measurement
- Electrostatic deposition enhancement
- Integrated vacuum pump

VITROCELL® Automated Exposure Station

Extended Version

Optional External or Integrated Dilution System

Optional Abrasive Dust Generator



Optional Abrasive Dust Generator

Optional Dilution System

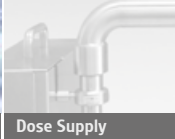
The picture shows the setup for C³ Carbon Concrete Composite project. It contains the VITROCELL® Abrasive Dust Generator, the VITROCELL® external dilution system and the extended VITROCELL® Automated Exposure Station. The Abrasive Dust Generator provides an aerosol to the dilution

system derived from the cutting process of e.g. carbon concrete. It is suitable to generate an aerosol from cutting and grinding processes of a range of different materials and workpieces. Individual dilution ratios can be adjusted at the external dilution system. In the following step the

aerosol is guided the Automated Exposure Station where cells are exposed at the air/liquid interface. Additional analytical modules for dose determination via Quartz Crystal Microbalances, TEM analysis as well as online mass spectrometry of the gas phase can be integrated.



Exposure Systems



Dose Supply



Dilution



Racks & Carts



Dose Monitoring



Skin Exposure



Auxiliary Equipment



Automated Exposure Station, Extended Version, with compartment for analytical equipment

Features

- Direct aerosol sampling
- Size selective inlet
- Automated process
- Temperature controlled system
- Integrated humidification of aerosol
- Aerosol flow control by mass flow controllers
- Touch-screen display
- Analytical modules for TEM and mass spectrometry
- Optional external or integrated dilution system
- Central data management system
- Online dose measurement
- Electrostatic deposition enhancement
- Integrated vacuum pump

Application Examples



**Tobacco Smoke/
E-Cigarette Vapors:**
whole aerosol and gas phase



Environmental Aerosol:
industrial emissions, exhaust gas from
combustion processes, environmental
pollutants in general, allergens

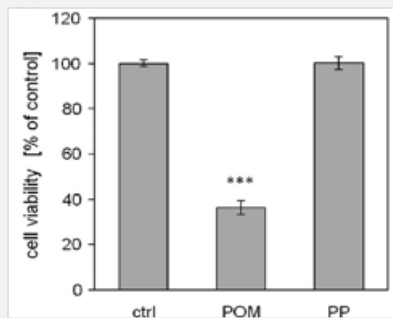


HICE:¹
combustion derived aerosols from
ship diesel and automotive engines
as well as from wood stoves

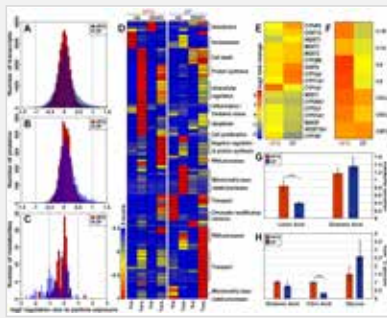
Aerosol Sources



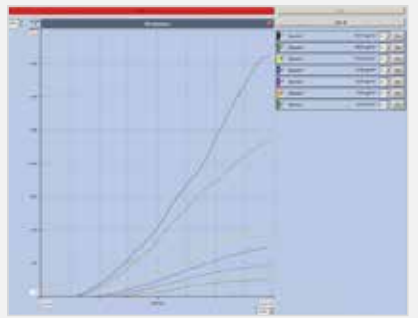
Test Results



Basic Assays:²
cell viability, cytotoxicity
see also VITROCELL® Assay Guide



Omics-Analysis:³
metabolomics, transcriptomics,
proteomics, micro-RNA



Dose monitoring:
online dose determination

¹ © panalot - Fotolia_69734198

² S. Mülhopt et al. / Journal of Aerosol Science 96 (2016) 38–55

³ Oeder S, Kanashova T, Sippula O, Sapcariu SC, Streibel T, Arteaga-Salas JM, et al. (2015) Particulate Matter from Both Heavy Fuel Oil and Diesel Fuel Shipping Emissions Show Strong Biological Effects on Human Lung Cells at Realistic and Comparable In Vitro Exposure Conditions. PLoS ONE 10(6): e0126536. doi:10.1371/journal.pone.0126536



C³ | carbon
concrete
composite

C³:
aerosol generated from cutting process
of carbon concrete composite



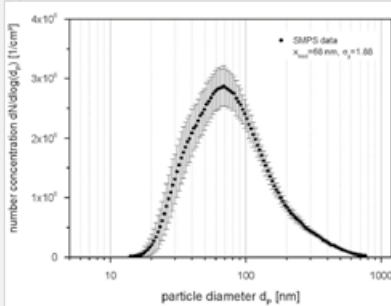
ProCycle

ProCycle:
aerosol derived from recycling
processes of nanocomposites

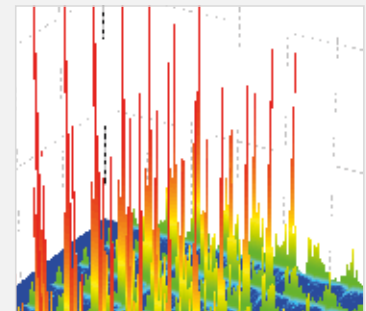
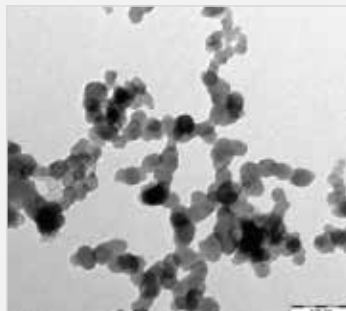


NanoMILE

NanoMILE:
investigation of nanoparticles



Physical Aerosol Characterization: ¹
number size distribution, morphology



Chemical Characterization:
mass spectrometry

Inlet with particle separation

A size selective inlet separates different fractions of aerosol according to the installed nozzle plate. The Inlet is adjustable to PM_{10} , $PM_{2.5}$ and PM_{10} .



Exposure modules

The base module accepts up to 6 cell culture inserts. Each cell culture compartment has an independent media reservoir. A transparent control window facilitates the external monitoring of media levels. The temperature is controlled by means of a water bath; therefore an additional incubator is not required during the experiment. The temperature for each module is individually monitored. The base module is made of electropolished stainless steel. It is autoclavable at $121^{\circ}C$ ($250^{\circ}F$) for 20 min.



Aerosol exposure top

The aerosol inlet stream flows through specifically shaped inlets which are optimized for electrostatic deposition. They are made of stainless steel with VITROGLIDE surface treatment. The stainless steel / VITROGLIDE inlets are specifically designed for the work with nanoparticles. The aerosol flow rate is controlled by mass flow controllers with data recording by the central data management system.



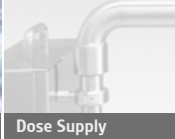
Isokinetic sampling system

The aerosol is guided into the central reactor of the system where it is humidified if needed. Distribution to the modules via isokinetic sampling probes enables high reproducibility and uniformity of results.





Exposure Systems



Dose Supply



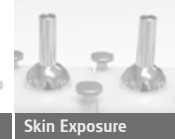
Dilution



Racks & Carts



Dose Monitoring



Skin Exposure



Auxiliary Equipment

Electrostatic deposition enhancement

A significant increase in deposition efficiency is achieved by applying an adjustable electrical field between aerosol inlet and cell culture.



Integrated Quartz Crystal Microbalance

The microbalance sensor is capable of measuring the deposition in the module at a resolution of 10 nanogram/cm² per second. The sensors can be placed in all media compartments to validate the mass deposition in the module. After validation they can be removed so that the experiment can be carried out using the cell culture inserts. One microbalance sensor can remain in the module to monitor the dose during exposure. The data is displayed online using the VITROCELL[®] Monitor software.



Touch-screen operation

All functions such as aerosol and vacuum flows, temperature, humidity automatic leak test, applied voltage for electrostatic deposition enhancement, start/end of the experiment can be edited using a large 15" touch-screen display. The central data management system provides valuable information on experiment parameters with user-friendly charts. The system can be networked and has a remote service module.



Keyboard

The keyboard can be used alternatively to the touch screen.



Dilution System

To provide different aerosol concentrations, a dilution system can be integrated into the station. The dilution ratios can be adjusted between 1:2 to 1:10



Analytic Modules

To analyze the aerosol at the same location than cell cultures, separate analytical modules can be integrated. They feature special inserts for TEM-Imaging, mass spectrometry of the gas phase as well as measurements of particle deposition via Quartz Crystal Microbalances.

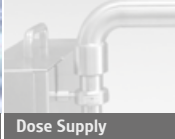


Time based Shut Down

The time based shut down feature offers the possibility to adjust dose by switching off the different levels at different time points. Defining dose by different exposure times is a valuable alternative if a dilution system can not be integrated.



Set of Photometers integrated in VITROCELL® Automated Exposure Station



Exposure Systems

Dose Supply

Dilution














Racks & Carts

Dose Monitoring

Skin Exposure

Auxiliary Equipment

Available Configurations

Level 1	Clean Air Control Module	Microbalance	High Voltage	TEM Analysis	Mass Spectrometry
		—	✓	—	—
		—	✓	—	—
		—	✓	—	—
Level 2	Exposure Module	Microbalance	High Voltage	TEM Analysis	Mass Spectrometry
		✓	✓	—	—
		✓	✓	—	—
		✓	✓	—	—
Optional Level 3	Exposure Module	Microbalance	High Voltage	TEM Analysis	Mass Spectrometry
		✓	✓	—	—
		✓	✓	—	—
		✓	✓	—	—
Optional Level 4	Exposure Module	Microbalance	High Voltage	TEM Analysis	Mass Spectrometry
		✓	—	✓	✓
		✓	✓	—	—
		✓	✓	—	—
		✓	✓	—	—

Technical Data

	Standard Version:	Extended Version:
Dimensions:	1.430 x 600 x 2.190 mm (L x W x H)	1.860 x 650 x 2.190 mm (L x W x H)
Weight:	405 kg – 460 kg *	510 kg – 565 kg *
Voltage:	230 V / 50 Hz, other voltages upon request	230 V / 50 Hz, other voltages upon request
Rating:	2.4 kW	2.4 kW
Fuse:	16 A	16 A
Compressed air:	6 bar (87 psi)	6 bar (87 psi)
Main Aerosol Flow:	1 m ³ /h	1 m ³ /h

* depending on configuration



Nozzles for connection to external equipment

About VITROCELL®

VITROCELL® exclusively concentrates on the developing, producing, installing, training and servicing of advanced *in vitro* exposure systems.

The VITROCELL® Systems' team is driven by their vision for new in-vitro standards through state-of-the-art technology, highly qualified workmanship and absolute client dedication. VITROCELL® has successfully collaborated with clients from leading research institutes, contract research organizations, regulatory authorities or industrial laboratories across the world. Working with our team experts, all modules have been tailored to create durable and complete turnkey-systems for *in vitro* inhalation toxicology. Gases, environmental atmospheres, nano particles and complex mixtures are analyzed on lung cells at the air/liquid interface using these systems. VITROCELL® technologies are also applicable to solutions for skin research.

Over a decade of devotion to research in this specific field has given our team of design & precision manufacturing specialists the opportunity to mentor highly diversified and complex projects **from conception to completion**. We strive to become a constructive member of each research team, providing support when it is needed, advice when it is required and modules of the highest quality, which are even polished by hand before leaving here to be integrated into your workspace. Every piece of our German engineered equipment is manufactured to the highest of standards – yours.

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