IUT Technologies
Founded in 1992

New Solutions for Airborne Molecular Contamination - Monitoring in Semiconductor & Microelectronic Manufacturing

Ion Mobility Spectrometry-based technology
by IUT Technologies GmbH, Germany

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Benefits of our technology

- Identification and quantification of AMC compounds
- Very low detection limits (ppt-range)
- No external carrier gas required and no consumables; therefore low operational cost
- Multiple substance classes in one solution (Total Acids / Total Amines / Ammonia / Total Solvents / Dopants) - real identification of particular substances
- Analysis directly in-situ in real time (response time within minutes)
- Measuring range from 0 to 30 ppb for all substances - ppt-sensitivity!
- Already installed in multiple wafer fabs in Europe

Effects of contamination on semiconductor manufacturing yield

AMC - Airborne Molecular Contamination describes a problem in the entire field of production of semiconductor devices based on silicon wafers in clean and ultra-clean rooms. Clean and ultra-clean rooms are required for special manufacturing processes where particles or chemicals present in ordinary ambient air would interfere with the patterning of integrated circuits within the range of fractions of a micrometer. The term therefore describes solid, liquid or gaseous contaminants in the cleanroom air which have undesirable chemical or physical effects on the manufactured workpieces. This includes, in particular, all chemicals used in various steps of the production processes in the so-called front-end manufacturing of semiconductor devices on silicon wafers.

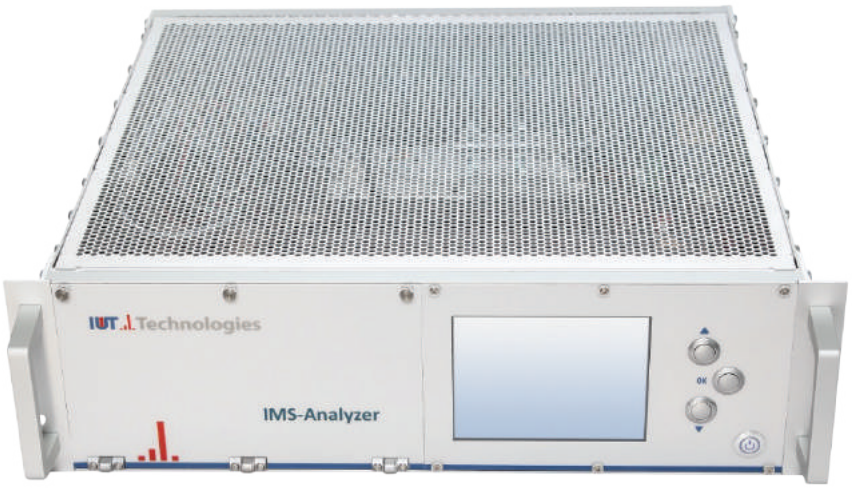
The processes and methods used and the chemicals used in these processes can be roughly divided into the

1. Patterning processes (mainly photolithography for patterning photoresist masks that cover areas on the wafer that are not to be treated (e.g., doped) in the subsequent steps). Solvents of the photoresists such as Acetone, NMP, TMAH (source of Trimethylamine), adhesion promoters like HMDS
2. Layer build-up processes (epitaxy, sputter deposition, vapor deposition, CVD, etc.), Silicon nitride from NH_3 and Dichlorosilane diborane, Phosphine,...
3. Process layer removal, and cleaning: (dry and wet chemical etching processes), HCl, HF,...
4. Processes for changing material properties (e.g. bakeout processes, doping, Silicide formation). Phosphine, Diborane and Arsine.

Why GC-IMS?

This trace-gas analyzer allows the detection and identification of gaseoussubstances without any enrichtment, directly in situ, at a very low concentration level. The detection including sampling and identification-process takes minutes to seconds, depending on the configurated setup.

For the enhancement / enabling of the selectivity and further reduction of cross sensitivities, the IMS-Analyzer is additionally available as a GC-IMS approach. Therfore the IMS is coupled with a gas chromatographic column (GC) for pre-separation and distinction of specific molecules. The GC-IMS version operates without external carrier gas, which keeps the operation costs low. As for the enabling of selectivity in Photo-Ionisation, our PID detector is coupled with GC pre-separation as a standard.



IUT-Technologies' AMC-Monitoring solution in detail

IMS-Analyzer

- Ion Mobility Spectrometry without GC pre-separation for faster response time
- Used for Acids, Ammonia & Amines

GC-IMS-Analyzer

- Ion Mobility Spectrometry with
- GC pre-separation for wide range of application Adjustable process specifics
- Used for Solvents

GC-PID-Analyzer

- Photo Ionization Detector with GC pre-separation for identification
- Used for Dopants

MPS

- Multi-Point-Sampling system
- Multiple devices with Master/Slave configuration
- Supports up to 61 measuring points

Cleanroom-proof wheels for individual placement of AMC-Monitoring system

Further additions

Calibrator

- Permeation-based
- Up to two substances/standards per device for continuous (re)-calibration of the analyzers

Dilution

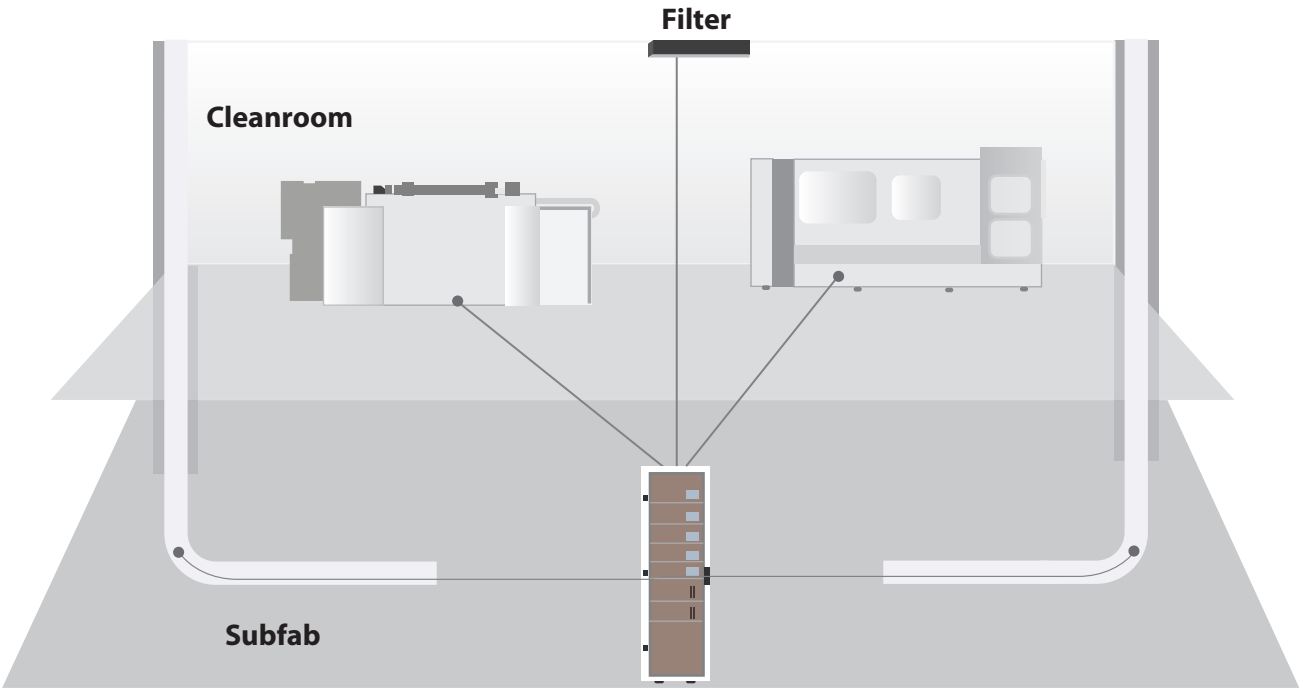
- Mass-flow-controller
- Fixed aerodynamic dilution ratios

Substance Class	Target Substance	Formula	CAS #	LOD [pptv]	Range [ppbv]
Total Acids	**Sulphur dioxide**	SO_2	7446-09-5	10	0 - 30
	Hydrogen chloride	HCl	7647-01-0	80	
	Hydrogen fluoride	HF	7664-39-3	130	
	Nitrogen oxide	NO_2	10102-44-0	190	
	Total			**10**	**0 - 30**
Ammonia	**Ammonia**	NH_3	7664-41-7	28	0 - 25
Total Amines / Total Bases	**Dimethylamine**	C_2H_7N	124-40-3	100	0 - 30
	Butylamine	$C_4H_{11}N$	109-73-9	40	
	Triethylamine	$C_6H_{15}N$	121-44-8	40	
	NMP	C_5H_9NO	872-50-4	100	
	Diethylamin	CH_3CH_2NH	109-89-7	50	
	Isopropylamin	C_3H_9N	75-31-0	50	
	Total			**40**	**0 - 30**
Total Solvents / Organics	**Acetone**	C_3H_6O	67-64-1	20	0 - 30
	Isopropyl alcohol	C_3H_8O	67-63-0	< 10	
	PGME	$C_4H_{10}O_2$	1320-67-8	< 10	
	PGMEA	$C_6H_{12}O_3$	108-65-6	< 10	
	Ethyl lactate	$C_5H_{10}O_3$	97-64-3	13	
	HMDS	$C_6H_{19}NSi_2$	999-97-3	10	
	Total			**< 10**	**0 - 30**
Dopant Gases	**Arsine**	AsH_3	7784-42-1	4500	0 - 500
	Phosphine	PH_3	7803-51-2	7400	0 - 500
	Boron trichlororide	BCl_3	10294-34-5	20	0 - 250

Specifications

AMC Monitoring System	
Principle of Operation	Multi analyzer setup, constiting of IMS, GC-IMS, GC-PID and Supplementary Devices (e.g MPS, Calibrator or Dilution); no carrier gas required
Resolution	± 2% of full scale
Operating specifications	
Operating ambient temperature	42 HU Rack: 15°C - 30°C / +59°F - 86°F
Output	Integrated graphical displays, RS 232/485, LAN/W-LAN (optional), Digital I/O, USB, Server
Maintenance rate	Two services per year (6-month interval)
Physical specifications	
Dimensions	42 HU Rack: 600 (W) x 1970 (H) x 1000 mm (D) 23.6 x 77.6 x 39.3 inch
Weight	Empty: 70 kg / 154.3 lbs Loaded: 250 kg / 551.2 lbs (can vary depending on system configuration)
Utility requirements	
Power supply	230 (115) VAC; 3 (5) A; 50 (60) Hz
Avg. power consumption	250 W (can vary depending on system configuration)
Peak power consumption	400 W (can vary depending on system configuration)
Intake flow	250 - 300 ml/min at atmospheric pressure (self-priming)
Sample exhaust	± 3.5 kPa (0.5 psi) (max.) at atmospheric pressure

Multi-Point-Sampling system



Sequential monitoring

- Within the measuring system, the MPS acts as a "master" which controls the gas measuring devices and their measurement in such a way that the results are assigned to the individual measuring points. The acquisition, processing, storage and transmission of the results is done in the associated MPS software.
- Controlled distribution of the sample gas from the measuring points to the measuring system by suction using integrated pumps.
- Possibility of backflushing the sample gas lines in the timeframe between measurements.
- Installation site of the measuring system can be spatially separated from monitoring areas (SubFab).
- Variable equipment for efficient assignment to individual monitoring areas/requirements.
- Possibility of optional equipment or gradual retrofitting.
- Basic realisation of redundant operation.
- Supports every industrial interface.