IAS

CSI Online Monitoring System

Continuous Chemical Sample Inspection

IAS Inc.

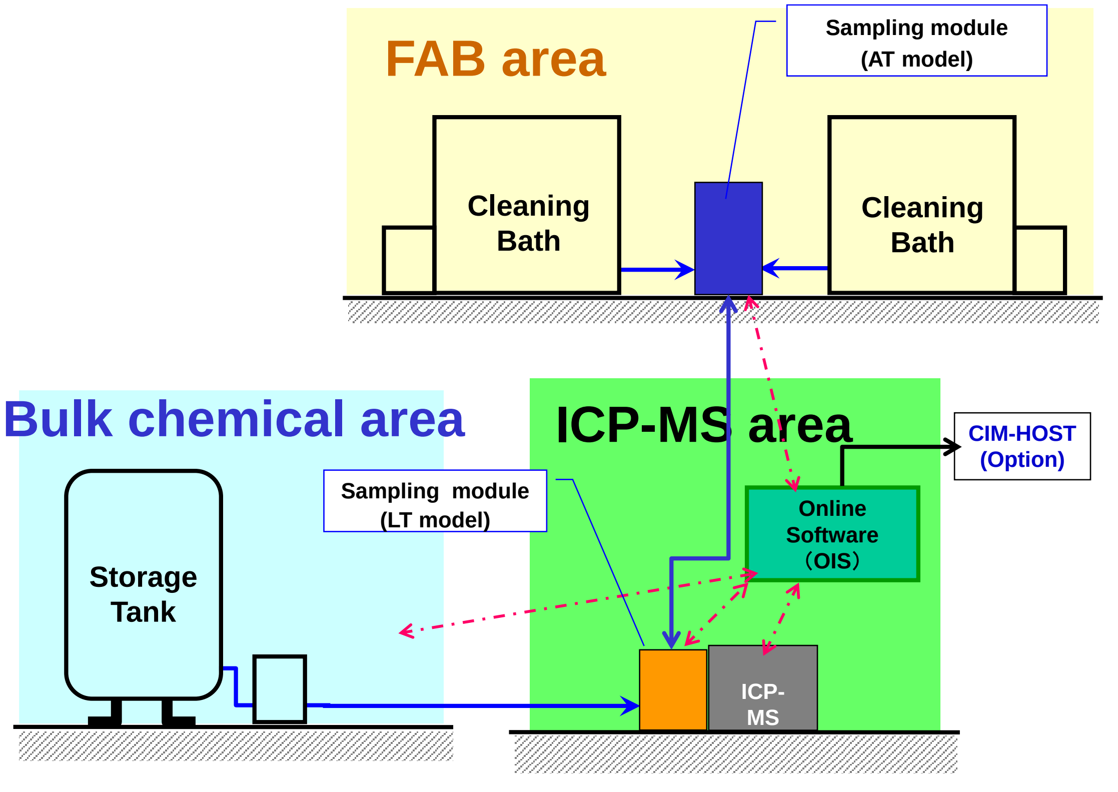
CSI monitors chemicals used in semiconductor FAB

Continuous Chemical Sampling Inspection (***CSI***) is a system that monitors ultra trace level of metallic impurities in chemicals used in semicondutor industries.

Semiconductor device manufacturing process repeats more than a few hundreds of deposition, etching, diffusion, implantation, lithography and cleaning steps. Many different types of chemicals are used for different purpose, and metallic impurities in chemicals cause malfunction of device.
Since a single wafer processing is getting popular, risk of cross-contamination in cleaning and etching processes is getting smaller. Instead, contamination of bulk chemicals causes a huge production loss. The contamination of bulk chemical may occur when chemicals are transferred from lorries or canisters to storage tanks or after replacement of filters.

In order to avoid any contamination risk in chemicals, ***CSI*** has been used to monitor metallic impurities in different storage tanks by one ICP-MS sequentially for 24-7. When a lorry comes, a sample from lorry is analyzed right after the current sample.

There are two types of sample transportation ways; liquid phase (***LT***) and aerosol phase (***AT***). ***LT*** model is designed for monitoring ***storage tanks, canisters*** and ***lorries*** that can determine ***a sub-ppt level*** of metallic impurities for almost all chemicals. Sample transfer tube should be connected to ***CSI*** directly. ***AT*** model is designed for monitoring **an accident** that can determine ***a single ppt level*** of metallic impurities for certain chemicals.



Example of CSI system

- **FAB area** - Chemical solution is taken from a recycling line of cleaning bath to the sampling module (***AT*** model) by using a narrow PFA tube (maximum 6 lines), and aerosol of selected chemical solution is generated by means of a special nebulizer and Ar gas. The aerosol is carried through a PFA tube by Ar gas and transferred to the ICP-MS. The maximum distance between the sampling module and ICP-MS is around 100 m.

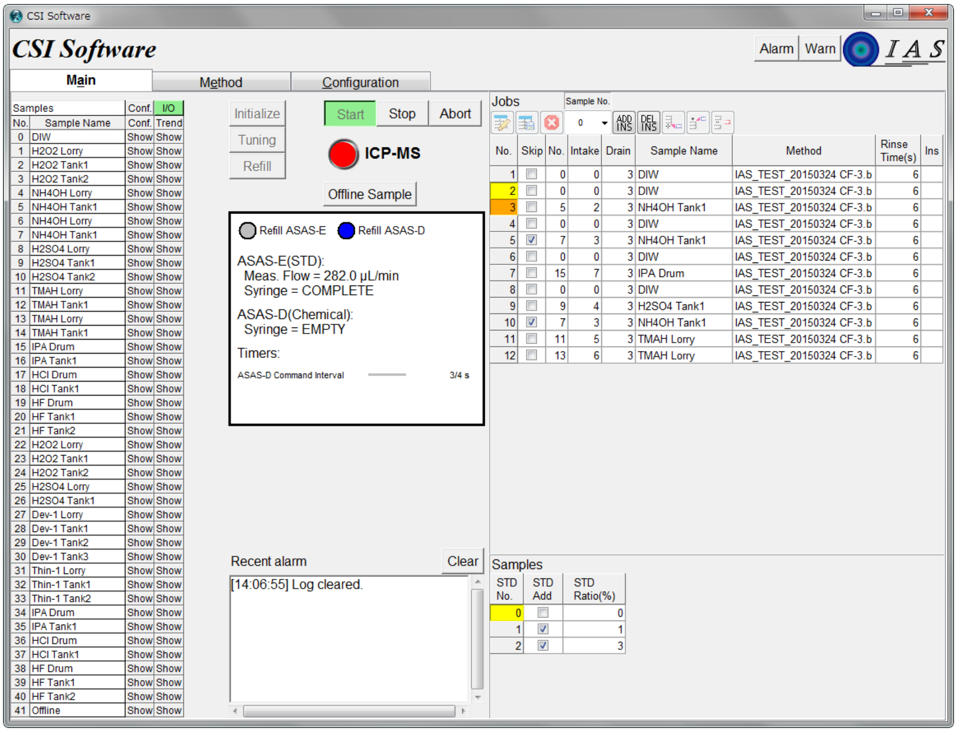
- **Bulk chemical area** – Bulk chemical is taken from an outlet of tank, canister or lorry to the sampling module ***(LT*** model) and analyzed by ICP-MS. Dilution of chemical with DIW at a certain ratio will be done if dilution of chemical is needed. There is no limitation of distance between tank or lorry and ICP-MS. Normally a recycle line is installed for tank chemical and a purge line is installed for lorry chemical.

- **ICP-MS area** – One of chemicals is collected in closed container, from which sample solution is self-aspirated by nebulizer of ICP-MS and analyzed by ICP-MS. The analysis is executed by the method of standard addition and ***ASAS*** (Automated Standard Addition System) adds standard solution into the self-aspirated sample solution line. There is no valve in the sample and standard addition line by ASAS that allows sub-ppt level analysis without memory issue.
  Drain lines are separated for different chemicals.

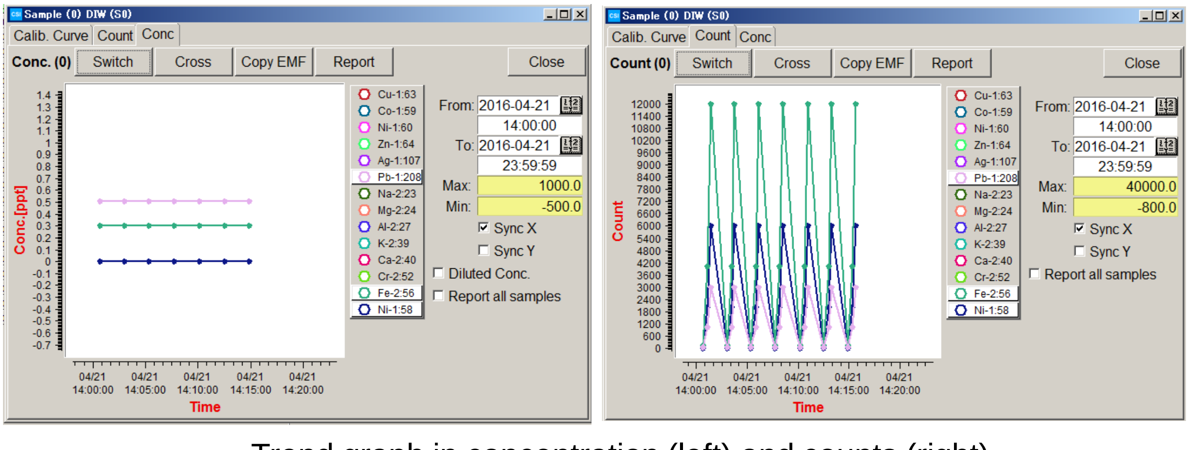
Typical chemicals analyzed at present are HF, H_2O_2, HCl, TMAH, NH_4OH, H_2SO_4, IPA, and Thinner. These chemicals are analyzed by only one ICP-MS sequentially for 24-7. The tuning condition can be automatically switched for each chemical.

◆ **CSI Online Interface Software (OIS)** – OIS is an intelligent software that controls each sampling module, introduction module and ICP-MS. ICP-MS is used as a detector and all information including calibration curve is managed by OIS.
OIS has the following functions

- Automated calibration and re-calibration by the method of standard addition.
- Check correlation coefficient of calibration curve, minimum sensitivity, SD and RSD, and automatic re-analysis function if results are out of limit.
- Periodic check of quality control standard (QC).
- Sensitivity compensation for each sampling module by internal standard.
- Two concentration upper limits, and generation of alarm and output signal.
- Insertion of lorry sample after the current sample.
- Change ICP-MS method for each chemical (depending on ICP-MS model).
- Trend chart in concentration and count for each sample.
- Communication with valve manifold boxes (VMBs).
- Communication with CIM-HOST in a FAB by SECS protocol. (Option)

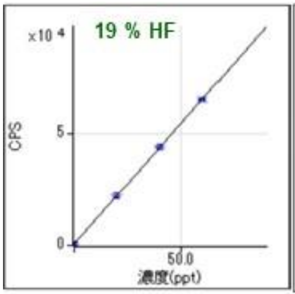


Main window of CSI software

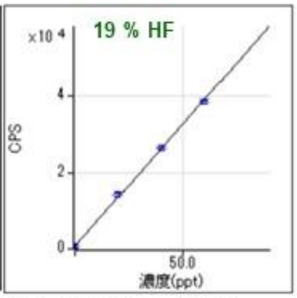


Trend graph in concentration (left) and counts (right)

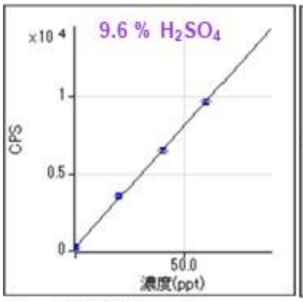
The followings are standard addition calibration curves of various chemicals analyzed by LT model. All chemicals were analyzed sequentially.



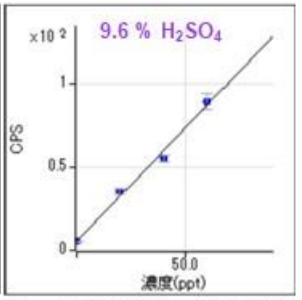
23 -> 23 Na [Warm]
y = 1.087E3 x + 6.540E2
R 1.0000
DL 0.07174
BEC 0.6015



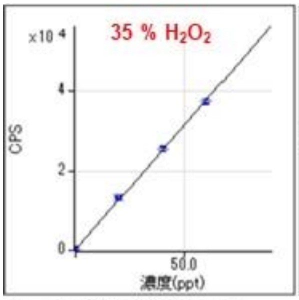
40 -> 40 Ca [Warm]
y = 6.415E2 x + 6.837E2
R 0.9997
DL 0.1121
BEC 1.066



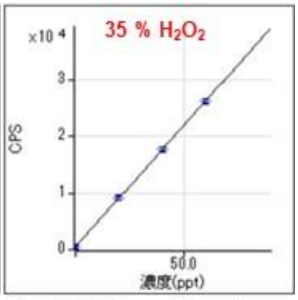
63 -> 63 Cu [Warm]
y = 1.579E2 x + 2.563E2
R 0.9998
DL 0.456
BEC 1.623



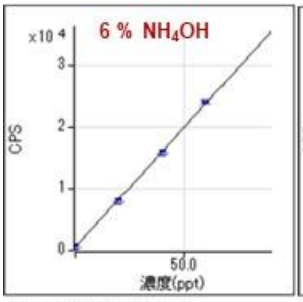
68 -> 68 Zn [HEHe collision(MSMS
y = 1.368E0 x + 5.333E0
R 0.9950
DL 1.458
BEC 3.898



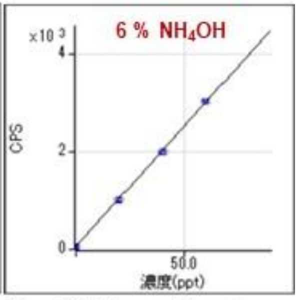
27 -> 27 Al [Warm]
y = 6.262E2 x + 2.327E2
R 0.9998
DL 0.0319
BEC 0.3715



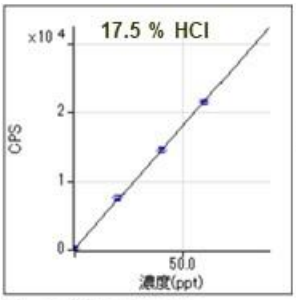
56 -> 56 Fe [Warm]
y = 4.318E2 x + 4.953E2
R 1.0000
DL 0.3311
BEC 1.147



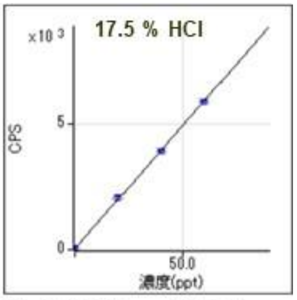
52 -> 52 Cr [Warm]
y = 3.886E2 x + 5.607E2
R 0.9996
DL 0.2714
BEC 1.443



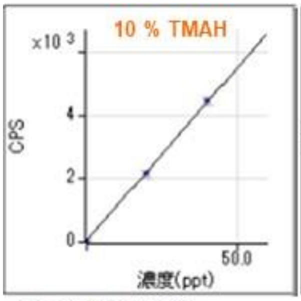
60 -> 60 Ni [Warm]
y = 4.944E1 x + 6.167E1
R 0.9998
DL 0.1263
BEC 1.247



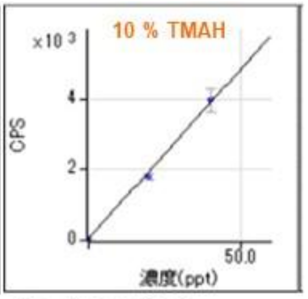
23 -> 23 Na [Warm]
y = 3.587E2 x + 1.980E2
R 0.9999
DL 0.1647
BEC 0.5519



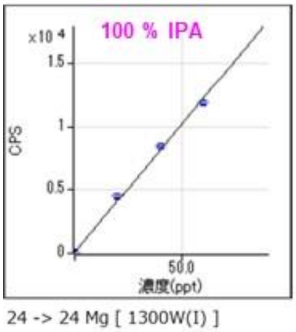
59 -> 59 Co [Warm]
y = 9.799E1 x + 3.500E1
R 0.9999
DL 0.2806
BEC 0.3572



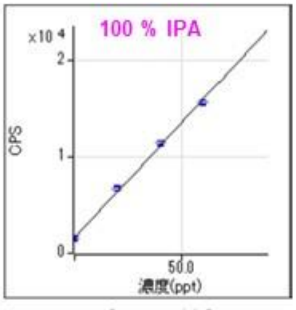
24 -> 24 Mg [Warm]
y = 1.090E2 x + 5.339E1
R 0.9996
DL 0.3182
BEC 0.4898



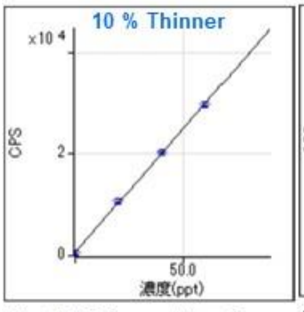
63 -> 63 Cu [Warm]
y = 9.607E1 x + 5.339E1
R 0.9981
DL 0.6507
BEC 0.5557



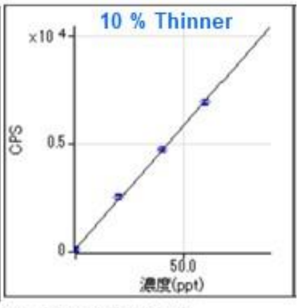
24 -> 24 Mg [1300W(I)]
y = 2.037E2 x + 7.534E1
R 0.9983
DL 0.994
BEC 0.3698



52 -> 52 Cr [1300W(I)]
y = 2.404E2 x + 1.591E3
R 0.9991
DL 0.2808
BEC 6.616

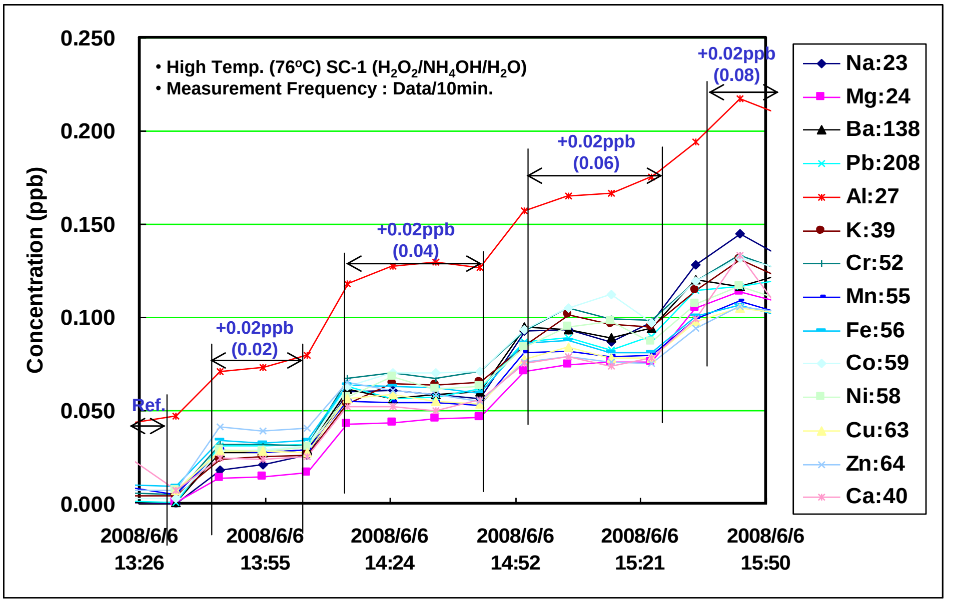


52 -> 52 Cr [[illegible]-Warm]
y = 4.889E2 x + 6.607E2
R 0.9999
DL 0.342
BEC 1.351

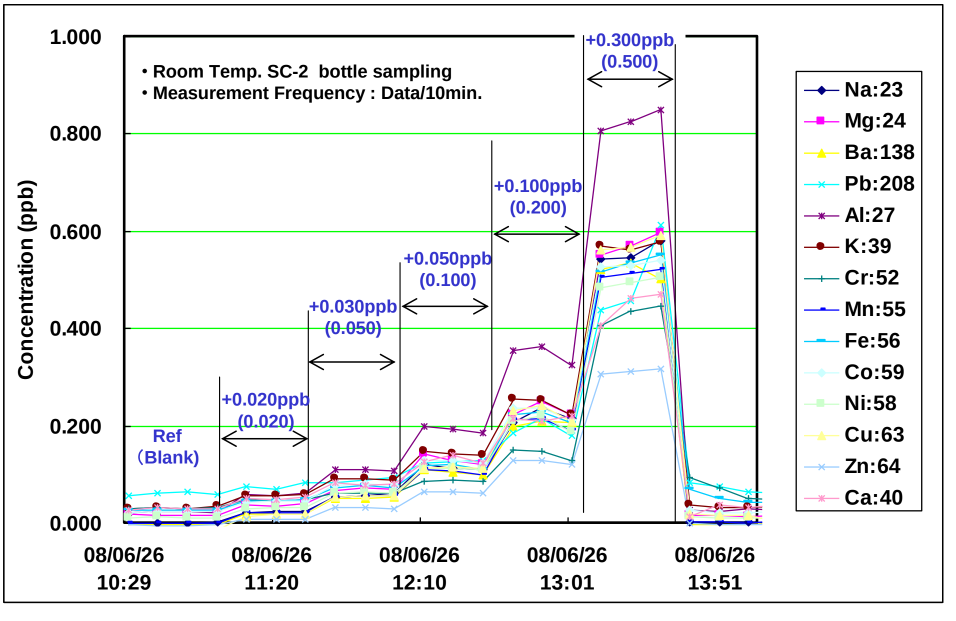


64 -> 64 Zn [Warm]
y = 1.148E2 x + 1.387E2
R 0.9998
DL 0.5068
BEC 1.208

The followings are trend graph of SC-1 and SC-2 chemical bathes obtained by AT model (100 m PFA tube). Mixed standard solution was spiked into each chemical bath. It took about two minutes to detect spiked standard elements after spiking.



Trend graph of SC-1 bath monitoring



Trend graph of SC-2 bath monitoring

IAS Inc.

2-2-1 Hinohonmachi, Hino, Tokyo, 191-0011 Japan
TEL: +81-42-589-5525
E-Mail: iasjapan@iasinc.jp URL: https://iasinc.jp

April 2022