
CONTAMINATION INTELLIGENCE & CONTROL STACK

Vocus + MMCC

From **chemical visibility** → to **FOUP-level control**

“Vocus identifies contamination. MMCC ensures it never reaches the wafer.”

Context — The Gap Today

Why this matters


Yield is now coupled to **low-pptv** airborne molecular contamination (AMC) — visibility and control must work together.


The Gap Today

Fabs can measure contamination in the **fab environment** — but cannot directly **see or control** what happens inside **FOUP and reticle micro-environments**.

 **Implication: AMC excursions can look “invisible” to standard monitoring, yet still impact queue-time risk.**

Close the gap

 **Vocus**
Molecular identification
Fab-level chemical truth

 **MMCC**
Embedded sensing
Always-on remediation

Combining molecular identification (Vocus) with FOUP-level control (MMCC) closes the gap between detection and yield protection.

Layered Integration Workflow

Four layers that connect identification to embedded action

LAYER 1

Discovery

Vocus maps AMC species, sources, and excursion patterns across bays, tools, FOUPs, and materials.

Output: compound fingerprints and event context.

LAYER 2

Model Translation (chemistry → action)

Select priority contaminant families per use case. Define thresholds, sensing chemistries, and decision rules.

Output: target set, thresholds, sensing chemistry plan.

LAYER 3

Embedded control

Configure MMCC inside FOUP and reticle environments with tuned sensing chemistries, thresholds, and selective remediation.

Output: always-on sensing + selective remediation.

LAYER 4

Feedback

Check MMCC telemetry and remediation outcomes against Vocus campaigns to refine models, media, and fab decision rules.

Output: continuous improvement and new-species capture.

 **Transforms chemical insight into FOUP-level decisions and actions.**
Identification stays auditable. Control stays embedded. Models stay current through verification.

Responsibilities — Who Does What

Clear role separation keeps diagnostics and embedded control optimized — while staying verifiable.

TOFWERK Vocus

Fab-level metrology & diagnostics

- Broad compound coverage with molecular specificity and untargeted discovery
- Ideal for manifold monitoring, point-of-use troubleshooting, FOUP screening, and materials/outgassing studies
- Acts as the analytical reference for qualification, source finding, and contaminant fingerprinting
- Defines ground truth required for calibration and validation of distributed sensing

Primary output

Compound fingerprints, event context, and fab-level “ground truth” datasets.

Ambient IoT MMCC

Embedded sensing & remediation

- Closed-loop platform using QCM/MOF sensing, predictive analytics, and selective getter control
- Localized deployment in FOUPs and reticle storage; queue-time-sensitive micro-environments
- Protects wafers and reticles during transport, storage, and waiting where facility filtration is insufficient
- Enables scalable deployment across FOUP fleets

Primary output

Always-on telemetry and event-driven remediation outcomes inside the micro-environment.

 Vocus answers what and why. MMCC answers when, where, and what to do next.

Implementation — From Truth to Control

 Designed for rapid OEM validation and scalable deployment.

A phased approach turns chemical truth into embedded action — then keeps performance verified as conditions evolve.

PHASE A

Characterisation

Deploy Vocus across selected fab locations and workflows to identify the species and event patterns that drive contamination risk.

Output: prioritized signatures and excursion context.

PHASE B

Model Definition

Translate signatures into target families, thresholds, sensing chemistries, and remediation strategies for FOUP and reticle deployments.

Output: configured MMCC rules + media plan.

PHASE C

Deployment

Feed MMCC telemetry—adsorption rate, acceleration, time-to-threshold, and getter events—into MES, yield, or engineering dashboards.

Output: actionable alerts and workflow signals.

PHASE D

Verification

Use periodic Vocus campaigns to verify MMCC response, catch new compounds outside the current target set, and refine analytics and media.

Output: continuous improvement and expansion.



Fast learning (Vocus → targets) + stable operations (MMCC → control), with periodic audits preserving confidence.

Separation of identification and control—connected through verification and model updates.

POC Strategy & Validation Path

De-risk deployment by proving correlation → prediction → controlled response.

 Vocus chemistry  Models & rules 

POC focus

Establish a defensible mapping from **chemical ground truth** to embedded signals and control actions.

Outcome: calibrated sensing, validated thresholds, and measurable response effectiveness inside FOUP/reticle micro-environments.

PHASE 1 — CORRELATION

Vocus chemistry  QCM/MOF signals. Identify key contaminant families and signal features.

PHASE 2 — MODEL DEVELOPMENT

Pattern recognition, threshold definition, and early prediction capability for actionability.

PHASE 3 — CONTROLLED RESPONSE

Simulated or real getter activation. Measure response effectiveness and refine decision rules.

 POC is focused on calibration, correlation, and prediction — not just sensing.

Pilot Plan — FOUP Roadmap

Start with fab-wide chemical truth, then deploy always-on FOUP control — validated by audits.

STEP 1

Baseline AMC map

Use Vocus to profile FOUPs, transfer points, and nearby process areas for priority AMC families and unexpected species.

Output: baseline risk map + fingerprints.

STEP 2

Target-family selection

Choose queue-time-relevant families, then configure MMCC sensing chemistries, thresholds, and getter media.

Output: targets + tuned control settings.

STEP 3

Embedded deployment

Install MMCC in selected FOUPs or storage environments for continuous sensing and event-driven remediation.

Output: always-on protection at point of risk.

STEP 4

Cross-validation


Run Vocus audits to confirm the right species are being reduced and identify contamination classes to add next.


Output: verified gains + next-iteration plan.

Success criteria

 **% reduction**
Priority AMC inside FOUPs

 **Correlation**
Vocus signatures ↔ MMCC events

 **Early detection**
Contamination trends over time

 **Excursion risk**
Demonstrated reduction in risk

Value **by Stakeholder**

A shared stack improves qualification, accelerates learning, and enables protection at the point of risk.

TOFWERK

Strategic upside

- Transforms Vocus from a diagnostic tool into an operational control platform
- Extends point measurement → distributed fab intelligence
- Strengthens position in OEM workflows through end-to-end validation

Ambient IoT

Ground-truth strength

- Gains broad-spectrum chemical evidence to tune MMCC targets and thresholds
- Validates platform behavior and remediation outcomes against Vocus campaigns
- Accelerates new sensing chemistries and selective media development

Fabs

Operational impact

- Broad AMC visibility + point-of-risk control inside FOUP/reticle environments
- Faster root-cause analysis and smarter maintenance through verified signatures
- Stronger queue-time protection during transport, storage, and waiting

 Extends chemical insight into actionable, distributed control.

Scientific & Industry Alignment

Credible execution at the intersection of semiconductor AMC control and MOF materials science.

Semiconductor expertise

Domain leadership for yield-critical AMC



Victor K. F. Chia

Clean manufacturing • OEM engagement • AMC control

- Aligns fab contamination monitoring with queue-time risk and qualification workflows
- Guides OEM-ready validation paths for FOUP and reticle micro-environments
- Ensures decisions remain auditable via ground truth correlation



MOF science leadership

Materials foundation for selective capture



Matthew Hill



Richard Robson

- MOF design for selectivity and capacity across relevant contaminant families
- Pathway to tunable media for predictive, embedded micro-environment control



MOF materials underpinning this approach are part of a field recognised by the 2025 Nobel Prize in Chemistry.

Bottom line: Combining semiconductor domain expertise with advanced materials science.

Execution Credentials

Proven distributed monitoring architecture, now extended to FOUP-level contamination control.

Proven deployment

Real-world distributed sensing

Where it's proven

- Distributed sensing in pharmaceutical cold chain
- Real-world monitoring across transport and storage

Outcome: reliable telemetry under variable logistics conditions.

System capability

Low-power, connected, real-time

What the platform does

- Low-power sensing platforms
- Multi-network connectivity
- Real-time telemetry and analytics

Outcome: scalable fleets + actionable signals.

Relevance

Why it maps to FOUPs

What changes in semicon

- Same architecture applied to FOUP environments
- Transition to molecular sensing + predictive control

Outcome: micro-environment decisions at point of risk.

 Proven distributed sensing platform — now applied to semiconductor contamination control.

Closing — Intelligence & Control Stack

Not just detection — a verifiable stack that turns chemical discovery into embedded action inside FOUP and reticle micro-environments.

TOFWERK Vocus Identify & quantify (ground truth)

What Vocus delivers

- Untargeted AMC discovery across bays, tools, FOUPs, and materials
- Compound fingerprints + excursion context for source finding and qualification

Output: fab-level chemical truth to calibrate and audit embedded sensing.

Ambient IoT MMCC Predict & remediate (embedded control)

What MMCC delivers

- Always-on QCM/MOF telemetry inside FOUP and reticle micro-environments
- Predictive thresholds + selective getter strategies for event-driven remediation

Output: micro-environment decisions and measurable remediation outcomes.

 This is the missing layer between contamination detection and yield protection.

→ Next step: Define pilot scope, target families, and verification cadence. {Owner / date}