Applied Microengineering Ltd.

PROCESS FLEXIBILITY

IN-SITU ALIGNMENT

SURFACE CHEMISTRY

ALIGNER WAFER BONDER

AWB PRODUCT information

ALIGN & BOND IN ONE SYSTEM

aml.co.uk

AWB

AWB-04: 3", 4" AND 6" WAFERS*
AWB-08: 6" AND 8" WAFERS*

TECHNICAL FEATURES

- In-situ alignment (visible and IR illumination) with 1µm accuracy
- Chamber pressure from 10-6 mbar range to 2 bar absolute
- Wafer separation up to 30mm (multi stack bonding possible)
- Independent platen temperatures up to 560°C
- Radical activation for low temperature direct bonding
- Bonding forces up to 40kN
- Anodic bonding voltage up to 2.5kV
- Triple stack anodic bonding
- Chip bonding option
- UV curing option
- NIR camera option

*AWB-04 and AWB-08 have the same chamber size and same footprint

ROCK

ROCK-04
3", 4" AND 6" WAFERS
ROCK-08
6" AND 8" WAFERS

TECHNICAL FEATURES

- All features of the AWB systems above
- UHV capability, down to 10-8 mbar range, achieved via a Cryo-pumping system
- Future development for automated loading

AML

Applied Microengineering Ltd.

ABOUT AML

Established in 1992, Applied Microengineering Ltd (AML) are based near Oxford in the UK. Located on Harwell Campus, the UK's leading science and innovation campus, and sited close to the Rutherford Appleton Laboratory (RAL), AML have access to RAL's cleanrooms and services in addition to our own in-house facilities.

AML design and manufacture integrated Wafer Bonding systems, including the unique capability for in-situ alignment of the wafers immediately prior to bonding. The aligner-bonder systems are readily configured to meet customer requirements and AML are receptive to discussing design modifications and to provide guidance on process development.

With a worldwide customer base, AML's systems have been supplied to leading universities and research institutes and, with the capability of handling wafers up to 8", are used for commercial device production.

ABOUT AWB

Aligner Wafer Bonders – AWB systems. The AWB systems provide outstanding flexibility and offer the capabilities for a wide range of bonding techniques. The systems feature an integral, optical wafer-to-wafer alignment system as standard, with the capability for 1µm accuracy.

The AWB system is available in two models, AWB & ROCK:

AWB-04: for 3", 4" and 6" wafer sizes
AWB-08: for 6" and 8" wafer sizes

ROCK: Provides the same in-situ alignment and bonding capabilities as the AWB systems and features a Cryopump for operation under UHV conditions, with vacuum levels in the 10-8 mbar range. The ROCK is available in either **ROCK-04** or **ROCK-08** configuration, depending on wafer sizes.

The systems are ideally-suited to process development and also enable high-yield bonding in production.

AML are renowned for, and committed to, the highest levels of global customer support.

BONDING TECHNIQUES

Anodic, Direct (high and low temperature), Eutectic, Thermocompression, Solder, SLID (Solid-Liquid Interdiffusion), Adhesive (thermal cure and UV cure), Glass Frit, custom bonding techniques.

AWB HOW IT WORKS

All bonding process steps, including any surface treatment and alignment, are carried out without any exposure to air:

- **Manual loading of the wafers**
- **Wafers held in separation, up to 30mm**
- **Pump-down, with operation under vacuum or controlled atmosphere**
- **Independent heating of the upper/lower wafers, up to 560°C**
- **Radical-activation of bonding surfaces, or removal of oxide from surfaces (via formic acid vapour)**
- **High-accuracy, in-situ optical wafer-to-wafer alignment, immediately prior to bonding**
- **Contact and bonding, with forces up to 40kN**

Both Manual and Automatic modes of operation are available. Auto mode allows bonding processes to run under recipes, including auto-aligning wafers.

COMMERCIAL BENEFITS

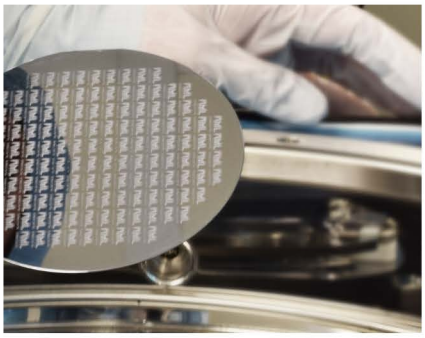
PROVEN: AWB systems are in operation at leading research institutes, universities and companies around the world

RELIABLE: market-leading systems offer high-reliability with minimal servicing

INTEGRATED: AWB systems offer both alignment and bonding capabilities, avoiding the need for two separate systems – reducing costs and operating complexity.

COMPACT: the AWB enables all stages of a bonding process to be carried out in a single chamber; the compact footprint results in minimal cleanroom space requirements.

EASE OF INSTALLATION: only power, nitrogen, compressed air and optional process gas required



DUAL OPTICS

OFFERING 1 µm POST-BOND ALIGNMENT ACCURACY VISIBLE ILLUMINATION, IR or NIR

SEPARATION

LARGE GAP BETWEEN WAFERS FOR EFFECTIVE PUMPDOWN, INDEPENDENT HEATING AND SURFACE TREATMENT

SPRING PIN

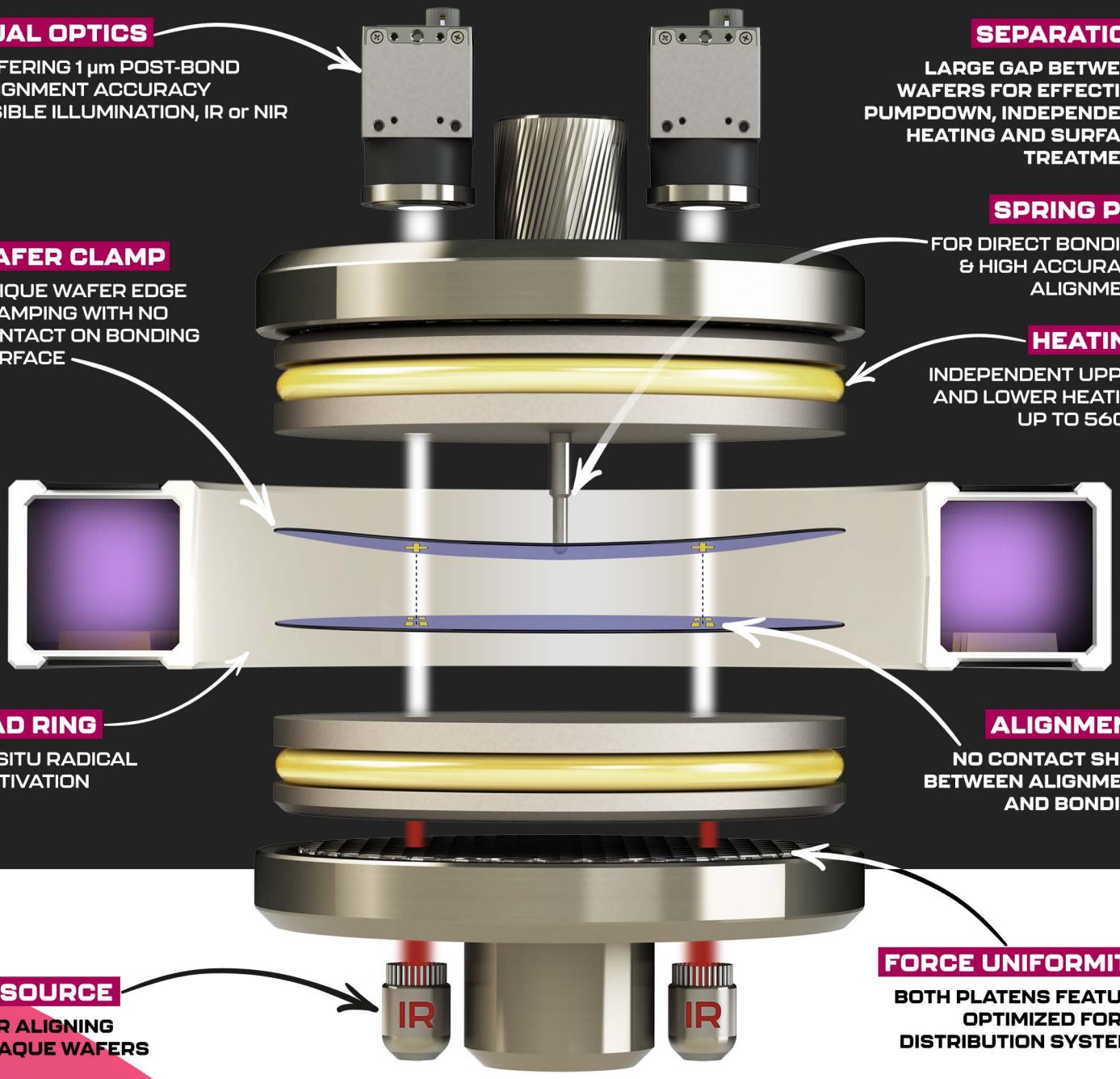
FOR DIRECT BONDING & HIGH ACCURACY ALIGNMENT

WAFER CLAMP

UNIQUE WAFER EDGE CLAMPING WITH NO CONTACT ON BONDING SURFACE

HEATING

INDEPENDENT UPPER AND LOWER HEATING UP TO 560°C



RAD RING

IN-SITU RADICAL ACTIVATION

ALIGNMENT

NO CONTACT SHIFT BETWEEN ALIGNMENT AND BONDING

IR SOURCE

FOR ALIGNING OPAQUE WAFERS

FORCE UNIFORMITY

BOTH PLATENS FEATURE OPTIMIZED FORCE DISTRIBUTION SYSTEMS

XYZ - THETA MANIPULATOR

ABILITY TO MOVE THE LOWER PLATEN FOR WAFER ALIGNMENT AND UP TO 40kN FORCE APPLICATION

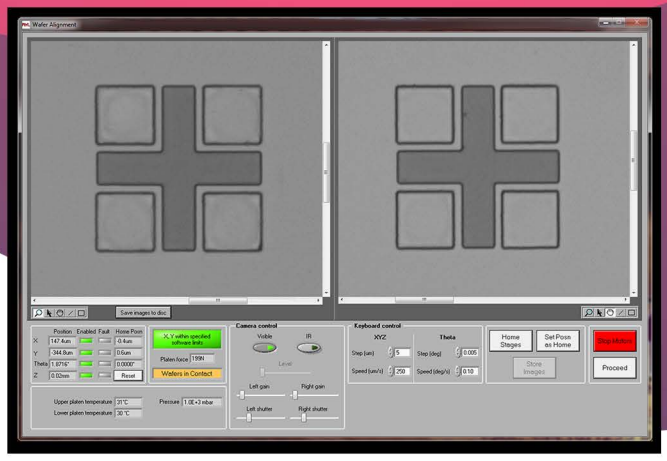
LIVE IN-SITU ALIGNMENT

Wafers are aligned using visible or IR illumination, to 1µm accuracy, immediately prior to contact and bonding. The live view provides visual confirmation and allows last-minute corrections, ensuring post-bond accuracy.

Alignment can be carried out at any desired temperature, eliminating inaccuracies due to thermal expansion and mismatch between wafers. The central pin is used to prevent contact shift. Image capture option is available for back side alignment.

Alignment can be performed manually or automatically.

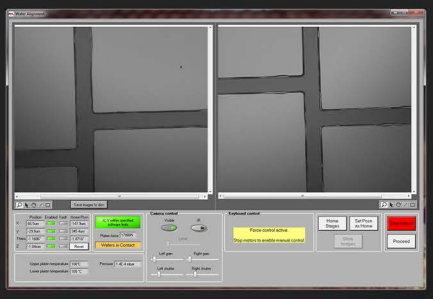
LIVE CAMERA VIEW



UNIQUE features

LIVE VIEW OF BOND FORMATION

The ability to observe bond formation in real time is an important advantage for process development. The visual information during bonding means that process parameters such as temperature and force can be adjusted as required. This feature can significantly reduce process development time and is particularly useful for interlayer bonding with adhesives, glass frit or metals.



Example - adhesive bonding: Force and temperature can be adjusted in real time to improve the adhesive flow and achieve void-free bonding.

WAFERS HELD IN SEPARATION

Wafers can be held apart, providing the following advantages:

- Independent heating of upper and lower wafers: e.g. useful for getter activation
- Rapid and effective evacuation of the chamber and wafers/cavities – important where vacuum-encapsulation or gas-encapsulation is required
- In-situ preparation of bonding surfaces - activation or oxide removal, as examples
- Bonding of wafer stacks, up to 30mm

RAD ACTIVATION

Neutral radicals from oxygen or nitrogen plasma are used for effective surface activation for low-temperature direct bonding processes.
The activation is accomplished in-situ, immediately before alignment and wafer contact, without exposure to air between stages.

AUTO VAPOUR INJECTION

This feature allows the wafer surfaces to be exposed to water vapour for hydration, to aid low-temperature direct bonding, or treated with acid vapour for oxide removal - for example, for Cu-Cu bonding.

CONTROLLED ATMOSPHERES

Bonding under vacuum, or a process gas at a controlled pressure between 2.5e-3 mbar and 2 bar absolute, is possible. Up to 3 process gas lines are available. Compatible gases include Nitrogen, Oxygen, Argon, Forming Gas, Helium, and many more.

CONTROLLED HEATING AND COOLING

Both upper and lower platens can be independently heated or cooled with desired ramp rates, to reduce bond stress. Controlled in 1°C steps, up to 560°C.

EDGE CLAMPING

Edge clamping ensures no contact with bonding surfaces, no contamination or risk of damage.

APPLICATIONS

- MEMS devices: pressure sensors, accelerometers, microfluidics
- High-accuracy aligned adhesive bonding
- Vacuum encapsulation
- Wafer Level Packaging - for MEMS and IC
- III-V bonding
- 3D Interconnects and TSV
- Advanced bonded substrates, for example silicon on glass
- Smart cut - Layer Transfer
- Quantum computing, using UHV capabilities

INTUITIVE USER INTERFACE

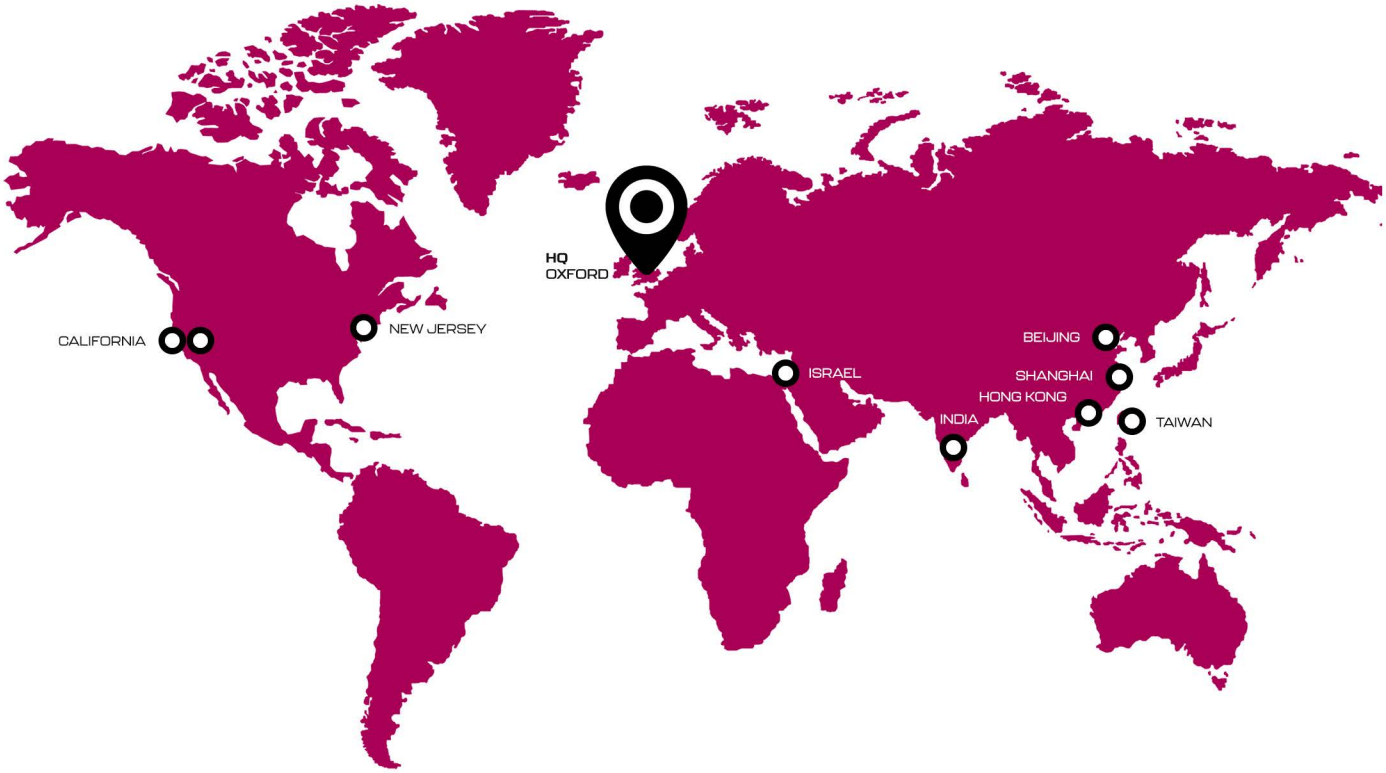
The User Interface provides clear displays and information on the system status, and offers full manual control and easy access to all functions.

Fully-automated bonding processes can also be accomplished via user-defined recipes, including auto-alignment.

Comprehensive built-in safety features protect both the operator and the system, and real-time data logging stores all bonding parameters for later analysis.

FOR MORE INFO, VISIT
WWW.AML.CO.UK

AML WORLDWIDE



AML provides global service and customer support both **directly from the UK and through field service engineers and local agents based in:**

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MORGANVILLE, NJ

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OXFORD, UK

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