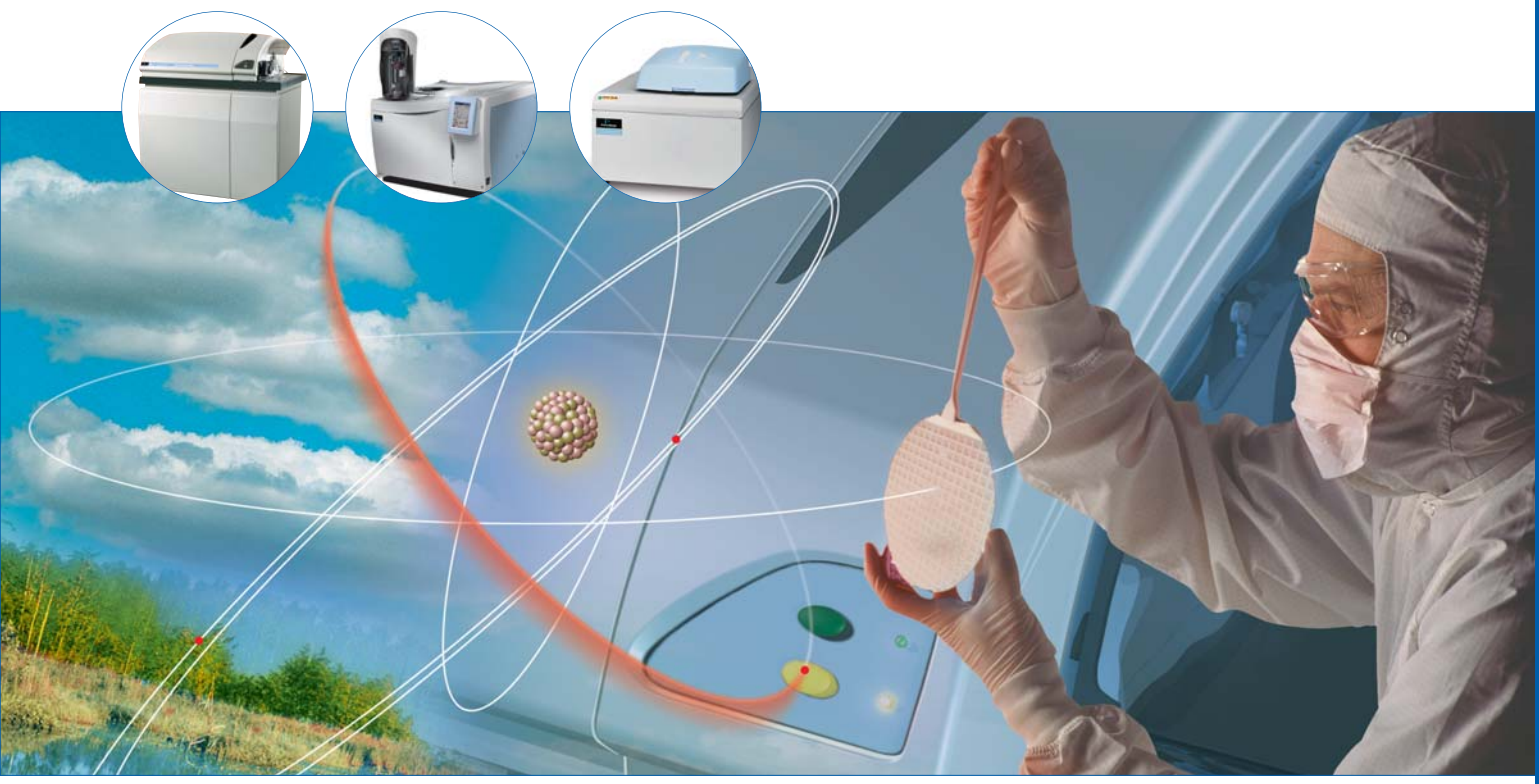
# Semiconductor capabilities



# support and solutions for your lab

PerkinElmer®
precisely.

# Who is PerkinElmer?

During the past decade, PerkinElmer has built a semiconductor focus team allowing a deeper understanding of this fast moving industry. Over the years, our product innovation and close attention to the needs of the semiconductor laboratory have moved our company into the position of industry standard for metals analysis in the semiconductor industry. The ELAN® DRC series of ICP-MS instruments has been embraced by over 140 semiconductor laboratories worldwide as the tool of choice for analyzing low level metals rapidly in virtually every semiconductor material.

Our semiconductor team measures high purity samples using an ELAN DRC II in our class 100 clean room.

What might not be apparent to our semiconductor customers is our full spectrum of laboratory products and services for the semiconductor laboratory including Gas Chromatography (GC), Gas Chromatography-Mass Spectrometry (GC-MS), Fourier Transformed Infra Red Spectroscopy (FT-IR), Ultraviolet Visible Spectroscopy (UV/Visible), Liquid Chromatography (LC), Thermal and Elemental Analysis, as well as Consumables and Service offerings. Throughout our entire product offering, PerkinElmer provides the most powerful analytical tools available coupled with unrivaled speed of analysis and best-in-class ease of use.

PerkinElmer's commitment to the semiconductor industry can be seen in the quality of those who lead our semiconductor business. A dedicated Global Semiconductor Business Development Manager consistently interacts with our semiconductor customers to assure our offering fulfills their needs. This team has many years of experience in the semiconductor industry and is most capable of understanding semiconductor market needs. Major investments have been made by PerkinElmer to assure we have clean facilities dedicated to our work with semiconductor materials. All turnkey methods, as well as samples analyzed for customer's evaluation, are performed in our class 100 semiconductor clean rooms. These facilities allow us to anticipate the needs of the rigorous analysis that will be expected of PerkinElmer instrumentation once installed in your facility. Our goal is to provide your laboratory with the analytical systems and appropriate support to help your laboratory obtain the lowest possible detection limits as rapidly and easily as possible.

## Inorganic Analysis

Shortly after the 1993 introduction of the first ELAN Inductively Coupled Plasma – Mass Spectrometer (ICP-MS), the semiconductor industry recognized the many possibilities of this new technology. Not only could detection limits be lowered for several elements beyond any other technology but the sub ppb determination of several elements in a single sample could also be achieved. As the industry embraced the technology, it soon learned that achieving the ultimate detection limits for many elements was limited by the interferences with ICP-MS. While high resolution and cool plasma techniques helped to reduce some of the interferences, these solutions introduced complexities of their own and still had limitations in many materials used in the semiconductor industry. Collision cell instruments introduced in the early 1990s also failed to provide the detection limits and speed of analysis required by the semiconductor industry.

### Dynamic Reaction Cell (DRC) Technology

In the mid-1990s, the market required an ICP-MS system providing low detection limits for all of the elements important to the semiconductor industry, in a wide variety of materials. This need was met by the ELAN DRC ICP-MS with ground-breaking patented reaction cell technology. The original ELAN DRC system has been improved and updated over the past decade and is now available as the ELAN DRC II ICP-MS system.

While not fully covering the scope of the reaction cell, here is a brief overview of how this patented technology provides interference-free analysis of samples. As the aspirated sample passes through the argon plasma of an ICP-MS, the analyte atoms are changed to singly charged ions. At the same time, other ions with a similar mass to charge ratio are formed that can not be differentiated by the ICP-MS from the analyte ions– thus acting as interfering ions. Fortunately, an active gas such as ammonia can be used in the reaction cell

*Table 1.* ELAN DRC II detection limits using one-second integration.

| Element (isotope measured) | DL in UPW | DL in 5% HF | DL in 10% $H_2SO_4$ | DL in 0.98% $H_3PO_4$ |
|---|---|---|---|---|
| B (11) | 1.93 | 0.5 | 5.5 | 10 |
| Na (23) | 0.14 | 10.7 | 0.3 | 14 |
| Mg (24) | 0.08 | 0.5 | 0.2 | 6.4 |
| Al( 27) | 0.05 | 2.0 | 0.7 | 3.1 |
| K (39) | 0.27 | 3.7 | 2.7 | 2.4 |
| Ca (40) | 0.10 | 0.7 | 0.7 | 3.5 |
| Ti (48) | 0.92 | 4.1 | 0.8 | 7.0 |
| Cr (52) | 0.12 | 0.8 | 0.8 | 3.6 |
| Mn (55) | 0.17 | 1.2 | 0.1 | 0.6 |
| Fe (56) | 0.12 | 1.1 | 1.4 | 12 |
| Cu (63) | 0.05 | 0.5 | 1.1 | 8.6 |
| Zn (64) | 0.45 | 0.8 | 16.0 | 6.0 |
| As (75) | 0.48 | 9.4 | 1.3 | 5.0 |

which reacts exothermally (quickly) with the interfering species and endothermally (slowly) with the analyte. This allows our analyte of interest to be kept in tact and measured, without impact from the interfering species.

Such technology can only result in a major benefit to a laboratory if it can be readily used without time consuming changes in the instrument configuration. The ELAN DRC II analyzes all elements in all sample types using a single set of plasma conditions, providing high sensitivity for all elements. Turnkey methods provided with the system automatically find which elements are best determined with DRC technology and which are best determined without DRC technology. This method can analyze a complete suite of elements in a single sample within five minutes, requiring virtually no operator intervention.

The detection limits achieved using Dynamic Reaction Cell technology are consistently best in class. All values in Table 1 are stated in PPT and were determined using a one-second integration. Those highlighted in blue were measured using DRC technology. All elements were measured using the same high temperature plasma conditions.

## Turnkey methods

The detection limits shown in Table 1 can be achieved in just minutes using turnkey methods provided with the ELAN DRC II. Table 2 contains the instrument parameters used for the analysis of 0.98% phosphoric acid. This method is called by the operator and automatically takes over the analysis of the phosphoric acid sample. Instrument parameters, including reaction gas flows, are automatically set to provide the ultimate detection limits in this demanding matrix. Since many elements can be analyzed best without the use of a reaction gas, the cell will be rapidly and automatically cleaned of all reaction gases for the analysis of those elements highlighted in yellow in Table 2. The end result is the PPT level analysis of a complete suite of elements, performed in minutes, without the need for operator intervention.

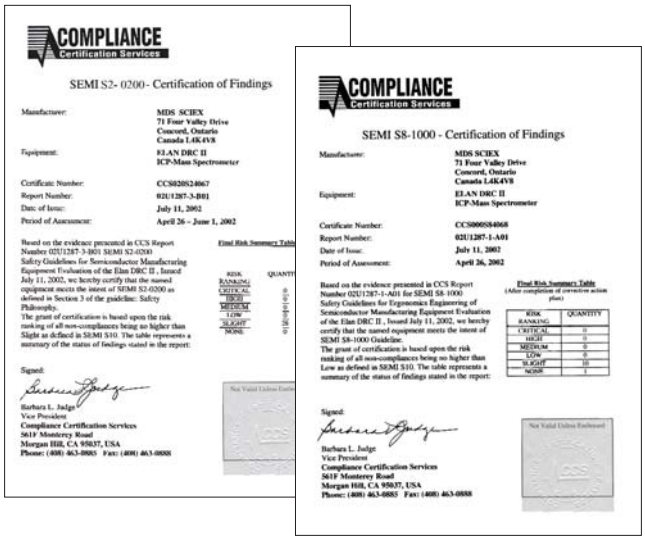
The ELAN DRC II provides the appropriate tool for obtaining accurate low level data quickly and with minimal operator intervention. This is the primary reason that, for many years, the ELAN DRC II ICP-MS has been the choice of more semiconductor laboratories than any other ICP-MS.

*Table 2.* Shows instrument parameters for 0.98% phosphoric acid analysis

| Element | m/z | RPq | Cell gas | Gas |
|---|---|---|---|---|
| Li | 7 | | | |
| Na | 23 | 0.25 | 0 | – |
| Mg | 24 | 0.25 | 0 | – |
| Al | 27 | 0.25 | 0 | – |
| K | 39 | 0.5 | 0.6 | NH3 |
| Ca | 40 | 0.5 | 1 | NH3 |
| Cr | 52 | 0.5 | 0.6 | NH3 |
| Mn | 55 | 0.5 | 0.6 | NH3 |
| Co | 59 | | | |
| Fe | 56 | 0.5 | 0.6 | NH3 |
| Ni | 60 | 0.25 | 0 | – |
| Cu | 63 | 0.5 | 0.3 | NH3 |
| Zn | 64 | 0.5 | 0.3 | NH3 |
| As | 75 | 0.25 | 0 | – |
| Sr | 88 | | | |
| Sb | 121 | | | |
| Au | 197 | | | |
| Pb | 208 | 0.25 | 0 | – |

## SEMI Compliance

To assure that the ELAN DRC II will meet global safety and ergonomic standards, PerkinElmer has obtained both the S2 (Safety and Health) and S8 (Ergonomics) certificates.



COMPLIANCE Certification Services

SEMI S2- 0200 - Certification of Findings

Manufacturer: MDS SCIEX, 71 Four Valley Drive, Concord, Ontario, Canada L4K4V8

Equipment: ELAN DRC II, ICP-Mass Spectrometer

Certificate Number: CCS020524067

Report Number: 02U1287-3-B01

Date of Issue: July 11, 2002

Period of Assessment: April 26 – June 1, 2002

Based on the evidence presented in CCS Report Number 02U1287-3-B01 SEMI S2-0200 Safety Guidelines for Semiconductor Manufacturing Equipment Evaluation of the Elan DRC II , Issued July 11, 2002, we hereby certify that the named equipment meets the intent of SEMI S2-0200 as defined in Section 3 of the guideline: Safety Philosophy.

The grant of certification is based upon the risk ranking of all non-compliances being no higher than Slight as defined in SEMI S10. The table represents a summary of the status of findings stated in the report:

Final Risk Summary Table

| RISK RANKING | QUANTITY |
|---|---|
| CRITICAL | 0 |
| HIGH | 0 |
| MEDIUM | 0 |
| LOW | 0 |
| SLIGHT | 0 |
| NONE | 0 |

Signed:

Barbara L. Judge
Vice President
Compliance Certification Services
5619 Monterey Road
Morgan Hill, CA 95037, USA
Phone: (408) 463-0885 Fax: (408) 463-0888

COMPLIANCE Certification Services

SEMI S8-1000 - Certification of Findings

Manufacturer: MDS SCIEX, 71 Four Valley Drive, Concord, Ontario, Canada L4K4V8

Equipment: ELAN DRC II, ICP-Mass Spectrometer

Certificate Number: CCS000504068

Report Number: 02U1287-1-A01

Date of Issue: July 11, 2002

Period of Assessment: April 26, 2002

Based on the evidence presented in CCS Report Number 02U1287-1-A01 for SEMI S8-1000 Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment Evaluation of the Elan DRC II , Issued July 11, 2002, we hereby certify that the named equipment meets the intent of SEMI S8-1000 Guideline.

The grant of certification is based upon the risk ranking of all non-compliances being no higher than Low as defined in SEMI S10. The table represents a summary of the status of findings stated in the report:

Final Risk Summary Table (After completion of corrective action plan)

| RISK RANKING | QUANTITY |
|---|---|
| CRITICAL | 0 |
| HIGH | 0 |
| MEDIUM | 0 |
| LOW | 0 |
| SLIGHT | 10 |
| NONE | 1 |

Signed:

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## Other Inorganic Techniques

If your analytical needs do not require the power or speed of reaction cell ICP-MS, PerkinElmer offers market leading products for Atomic Absorption (AA) and Inductively Coupled Plasma Optical Emission (ICP-OES) analysis. Our AA instruments have the leading technology available including a Transversely Heated Graphite Furnace and longitudinal Zeeman-effect background correction. These instruments provide the lower sample volume laboratory with a reliable and economical means to analyze a wide spectrum of elements in semiconductor materials. Our ICP-OES systems provide high sample throughput where the lowest detection limits are not needed. For well over a decade, the Optima™ ICP-OES systems from PerkinElmer have been recognized as the ultimate systems for reliability and throughput.

# Organic Analysis

## Airborne Molecular Contaminants (AMC)

While traditional monitoring of the clean room atmosphere has focused on the measurement of small particles, laboratories are broadening their focus to include Airborne Molecular Contaminants (AMC). For the measurement of organic AMC, Thermal Desorption GC is an indispensable tool. PerkinElmer is able to combine its decades of experience with GC sample handling and GC instrumentation to provide an easy-to-use, proven system for measuring organic airborne contaminants. Both the TurboMatrix™ Thermal Desorber and the Clarus® GC are controlled by full-color, easy-to-use touch screens that interface with the operator in eight different languages.

PerkinElmer Clarus GC interfaced to the TurboMatrix Thermal Desorption system

Optima ICP-OES spectrometer

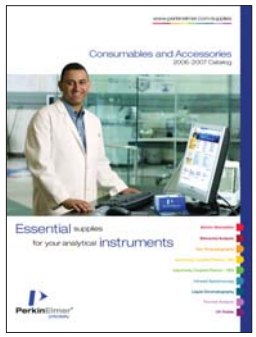
## Thermal Analysis

When melting temperatures, degree of cure, dimensional changes, or outgassing are a concern, one of the many PerkinElmer thermal analyzers may be the appropriate analysis tool. Our full offering of thermal analysis products includes Differential Scanning Calorimetry (DSC), Thermal Gravimetric Analysis (TGA), Thermomechanical Analysis (TMA), Dynamic Mechanical Analysis (DMA), and the combined techniques of Thermogravimetric/Differential Thermal Analysis (TG/DTA). Our thermal analysis products may be used for R&D or for routine quality control. Flexibility and ease of use are just two of the strengths of this proven family of products.

Diamond Differential Scanning Calorimeter

## Other PerkinElmer products

Other techniques used in the semiconductor industry include LC, FT-IR, and UV/VIS. PerkinElmer offers a full line of high- quality products for these techniques as well. You can access information on all PerkinElmer Analytical Products from our web site at http://las.perkinelmer.com




### Consumables

To obtain optimal performance from all of your PerkinElmer analytical instrumentation, it is critical to have a ready supply of PerkinElmer consumables. PerkinElmer maintains inventory of all commonly used consumables in strategic locations around the world. Consumables may be easily ordered using the internet or by phone.

## Global support

With the ever increasing focus on global standardization, it is critical for all of our analytical products to be backed with exceptional application and service support. Our application scientists are located in every major semiconductor manufacturing area and are backed by a Semiconductor Application Center which focuses exclusively on the needs of this industry. Our service engineers, located in every major country of the world, are employees of PerkinElmer and have been thoroughly trained on the maintenance of our high-quality instruments as well as the specific needs of the semiconductor industry.

As a world leader in analytical instrumentation, and with over 60 years of experience, PerkinElmer is the premier partner for the semiconductor industry.

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**For a complete listing of our global offices, visit www.perkinelmer.com/lasoffices**



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