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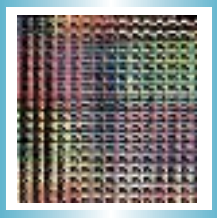
THE GLOBAL OUTLOOK FOR CHEMICALS AND MATERIALS IN COMPOUND SEMICONDUCTORS, 2002-2007



Revised Edition

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OVERLOOK AT GREAT NOTCH
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Compound semiconductors are used in many types of communications and photonic devices. The total market for these devices is approximately $11 billion in 2003 and is growing rapidly. Wireless devices, light-emitting diodes, lasers, UV detectors, solar cells, and many other types of photonic devices rely on compound semiconductors. Compared to conventional silicon-based semiconductors, compound semiconductors produce integrated circuits that are:

- Faster
- Operable to higher frequencies (hence, greater bandwidth)
- Capable of emitting or detecting visible light and infrared radiation
- Radiation-resistant
- Heat-resistant

There are many types of compound semiconductors being produced commercially. The main categories, which will be the subject of exhaustive analysis in this report, include:

- Combinations of Group IV elements, such as
  - Silicon-germanium
  - Silicon-carbide
- Combinations of Group III with Group V elements, including
  - Indium phosphide
  - Gallium nitride
  - Mercury cadmium tellurium
  - Indium gallium phosphide
  - Aluminum gallium phosphide
  - Aluminum gallium nitride
  - Indium antinomide

Using information garnered from interviews with device fabricators, tool producers, materials suppliers, and other value chain participants and market makers around the world, Kline has profiled the markets for these compound semiconductors, as well as the critical and ancillary materials needed to produce them. Ancillaries include photoresists, etchants, and cleaning compounds. The profiles include segmented estimates of volume of production, market value, growth, and supplier shares.

In the preparation of its market projections, Kline has employed a forecast model that takes into account changes in device fabrication techniques expected in the years to come. In assembling the model, Kline has undertaken an extensive assessment of technological as well as economic trends.

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BACKGROUND

Compound semiconductors have been around for many years, but the market is minor compared to silicon-based chips. They are more expensive to build, melting points are lower (which compromises fabrication), and they lack a natural oxide that can serve as a dielectric medium. The basic boules from which wafers are cut are much smaller in diameter, and some compounds such as gallium nitride are not at all available in bulk boules. As a result, semiconductor processing has gone overwhelmingly to silicon.

But compound chips have some valuable advantages: They can react to microwaves in real time, converting them to electrical signals; they emit light; and they withstand radiation (a property put to good use in satellite circuitry) and extreme operating temperatures.

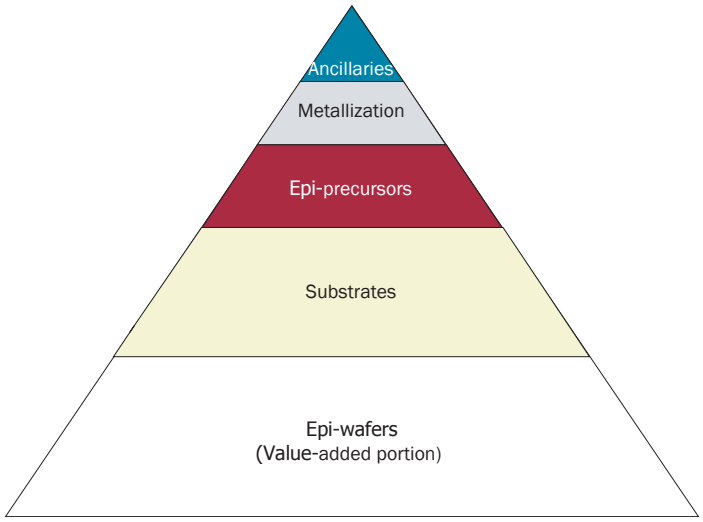
Superior performance in photonics, however, explains most of the current excitement over compound semiconductors.

Applications exist today that were not around when gallium arsenide was first developed, especially digital display appliances and mobile communications. The market has caught up to this technology, and compound semiconductors are finally poised for strong growth—growth that should exceed that of silicon-based integrated circuits in the years to come.

Understanding the market for consumables in compound semicondustors can assist suppliers and other companies in developing the strategies needed to win in this market. Key consumables utilized in this market include those shown in Figure 1.

Figure 1

SCOPE OF THE COMPOUND SEMICONDUCTOR MATERIALS BUSINESS



RESEARCH METHODOLOGY

Kline has employed a proven approach to this study in order to gather, analyze, and confirm the informational inputs that are required to construct a comprehensive report for ***THE GLOBAL OUTLOOK FOR CHEMICALS AND MATERIALS IN COMPOUND SEMICONDUCTORS, 2002-2007***. The components of this multi-method approach include the following:

- **Field interviews**
  The foundation of information and insight needed to complete these studies has been developed through an extensive series of field interviews with key industry participants in **Europe, Japan, Taiwan, and the United States**, including (1) leading electronic device and semiconductor manufacturers, (2) manufacturers of consumables and process equipment, and (3) all pertinent government agencies and trade factors.
- **Analysis of key insights and industry trends**
  Technology, economic, market, and supply factors has been be analyzed to assess the current industry structure and to identify key trends. During this analysis, we have utilized knowledge and expertise from our previous programs to realistically predict likely future process scenarios.
- **Market modeling**
  Kline has applied the knowledge gained through primary research and a review of technical and trade literature with a proprietary modeling algorithm that takes individual process steps into account for purposes of a bottoms-up transformation of chip counts to raw material consumption.
- **Technical experts**
  Kline has engaged a technical adviser for this report. Previously published studies in Kline's series on semiconductor materials relied on the advice of process technology managers from fabricating companies. It should be noted, however, that experts participating in this study do so on an individual basis, not as representatives of their companies.

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Kline & Company, Inc. is an international business and management consulting firm offering a broad range of services to the electronics, specialty chemical, and advanced materials industries.

The firm has provided consulting services to organizations active in all sectors of the global electronics industry, including electronic systems and devices, batteries, semiconductors, and printed wiring boards, as well as electronic chemicals and materials.

Our headquarters are located in Little Falls, NJ, and we maintain representative offices in:

- Brussels, Belgium
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Since its inception in 1959, Kline has earned a reputation for delivering high-quality studies and market and technology assessments. We complete approximately 200 proprietary assignments and publish approximately 20 multiclient research reports each year.

Over the last four years, Kline has completed more than 50 projects related to electronic materials and technologies. Many of these assignments have investigated the market opportunities for new technologies with various performance capabilities. Other projects have evaluated new market opportunities for companies considering entering the electronics industry and have assisted suppliers of electronic raw materials in identifying future material needs.

In addition to studies on dielectrics, Kline has undertaken related studies into CMP technology and materials, which analyze the market for CMP slurries, pads, brushes, filters, and other materials. The first edition of ***THE GLOBAL OUTLOOK FOR CHEMICAL MECHANICAL PLANARIZATION TECHNOLOGY AND MATERIALS*** covered the forecast period of 1998 to 2003. A completely revised and expanded edition of this study covering the 2000 to 2005 period is now available.

THE GLOBAL OUTLOOK FOR CHEMICALS AND MATERIALS IN COMPOUND SEMICONDUCTORS, 2002-2007 is the latest in a new series of reports on emerging electronic technologies.

Recently, Kline completed four reports on back-end-of-the-line precursor materials. The first, titled ***THE GLOBAL OUTLOOK FOR CHEMICAL MECHANICAL PLANARIZATION TECHNOLOGY AND MATERIALS, 2000-2005***, was issued in fall 2001. The second, issued in February 2002 and titled ***DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES TO THE SUB-0.10-MICRON DESIGN RULE***, updated an earlier groundbreaking study on the burgeoning market for low-k dielectrics.

Kline also published its new study on the photolithography market, titled ***THE GLOBAL MARKET FOR RESIST, ETCH, AND CLEANING MATERIALS FOR SUB-0.25-MICRON SEMICONDUCTORS, 2001-2006***, in May 2002. This was followed in July 2002 by the fourth study on BEOL precursors, titled ***THE OUTLOOK FOR ADVANCED INTERCONNECT METALLIZATION PRECURSORS AND PROCESSES TO THE 70-NM DESIGN RULE***.

All of these reports employ proprietary line modeling systems that project the markets for consumables and equipment based on device-specific forecasts for such metrics as interconnection layer counts, design-rule progression, and end-product demand.

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THE GLOBAL OUTLOOK FOR CHEMICALS AND MATERIALS IN COMPOUND SEMICONDUCTORS, 2002-2007

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