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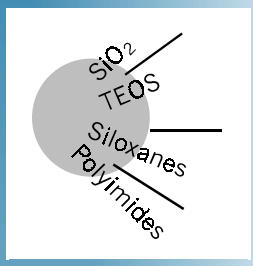
THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004



THE SECOND REPORT IN KLINE'S NEW SERIES ON EMERGING ELECTRONIC TECHNOLOGIES

Kline & Company, Inc. is undertaking the first detailed analysis of the technology drivers that are pushing the rapid change in dielectric materials used in semiconductor devices, with particular attention to new low-k dielectrics.

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THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004 is designed to help strategic planners involved in the supply of materials to semiconductor manufacturers better understand the timing and impact of the inevitable change in semiconductor dielectric materials. The service is designed to provide the global information and analysis that will enable strategic planners to effectively anticipate, plan, and respond to the evolution of the semiconductor device fabrication processes. Specifically, the report provides subscribers with the following benefits:

- An accurate prediction of the commercial impact and timing of new dielectric technology as well as conventional dielectrics in each major semiconductor market segment
- Profiles of dielectric material suppliers, including a discussion of their technology and the possibility for acquisition/alliance
- Identification of opportunities for related materials and equipment, including chemical vapor deposition (CVD) and spin-on equipment

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THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004

DIELECTRIC MATERIALS

The semiconductor industry is quickly approaching a point at which conventional silicon dioxide dielectrics are inadequate for the job for which they are intended—insulating metal interconnects in ever-increasing scale of integration, and increased speed as well. The problem lies in the resistance-capacitance delay (RC delay), a physical fact of life that dictates that as capacity effects the metal, interconnects crowd closer together and slow down processing. What is needed is an insulator with a lower dielectric constant than the value of 4.2, also expressed as k value, for silicon dioxide.

Kline's report looks at the total market for dielectrics in so-called "back-end-of-the-line" (BEOL) fabrication. This includes premetal, interconnect, hard mask, etch stop, and final passivation layers. These are all insulation layers of varying thickness, and which perform different functions. Kline's analysis puts the total global market for these materials at approximately $425 million in 1999, growing at a rate of 23% per year to nearly $1.2 billion in 2004, as shown in Figure 1.

Although Kline's report studied the entire market for dielectrics, it devoted much of its attention to the burgeoning low-k market. This market is segmented as shown in Table 1, which identifies some of the current candidate materials that are commercially available or under development.

RESEARCH METHODOLOGY

Kline developed a rigorous research methodology for this study in order to gather, analyze, and confirm the informational inputs required to construct a comprehensive report on **THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004**. This includes:

- **Primary field interviews**
  The foundation of information and insight needed to complete this analysis has been developed through an extensive series of field interviews worldwide with key industry participants, including: (1) leading electronic device and semiconductor manufacturers; (2) dielectric material suppliers; and (3) all pertinent

Figure 1

DIELECTRIC MATERIALS BY LAYER TYPE, 1999-2004

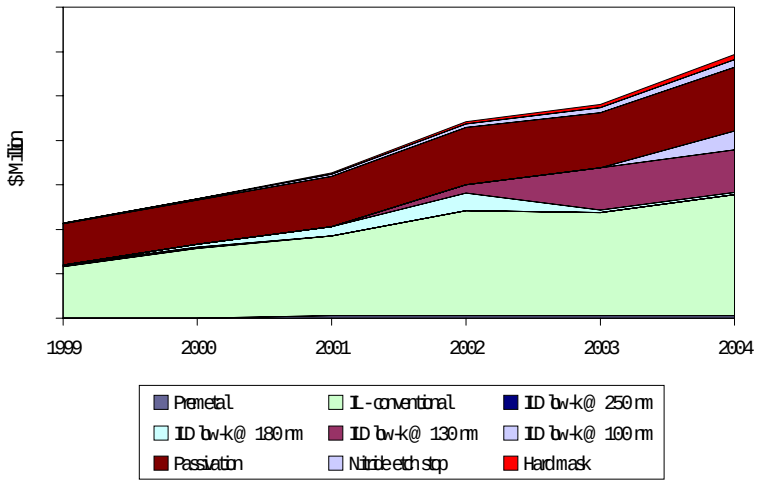

Table 1

CANDIDATE LOW-K MATERIALS

Chemical class	CVD	Spin-on
Inorganic	Fluorinated silicate glass (FSG)	Porous silica-a
Organic	Fluorinated amorphous carbon (FLAC); parylene	Poly(arylene ether), poly-tetrafluoroethylene
Organo-silicon compound	Carbon-doped glass, silicon carbide	Siloxanes, benzocyclo-butene, silsequioxanes

a- Contains some organic content for hydrophobicity.

government agencies, industry associations, and relevant trade factors.

- **Data analysis**
  Technology, economic, market, and supply factors has been analyzed to assess the current industry structure and to project the demand for low-k dielectric materials to 2004.

- **Technical expert**
  Kline has engaged the technical expertise of Dr. Carlye Case as a technical advisor. Dr. Case is a member of the technical staff, Silcon Laboratory, Bell Labs - Lucent Technologies, Murry Hill, NJ. Dr. Case has published several papers on dielectrics in general, and low-k dielectrics in particular. She holds a Ph.D. in chemistry from Brandeis University.
  NOTE: *Dr. Case has participated in this study on an individual basis and not as a representative of Lucent Technologies.*

HOW TO SUBSCRIBE

THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004 is available only by subscription. To subscribe now, please complete the attached subscription agreement form and forward it to any of our offices. To obtain further information or more details regarding the study, please contact us at any of our global locations listed on the back cover.

QUALIFICATIONS

Kline & Company, Inc. is an international business consulting firm offering a broad range of services to the electronics, specialty chemical, and materials industries. Kline has established a dedicated business and management consulting practice in the global electronics industry. The firm has provided consulting services to organizations active in all sectors of the 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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We have a reputation for delivering high-quality studies and market and technology assessments. We complete approximately 200 proprietary assignments and nearly a dozen multiclient research reports each year. Over the last ten 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.

THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004 is the second in a new series of reports on emerging electronic technologies. In late 1998 Kline completed a major analysis, *CMP TECHNOLOGY AND MATERIALS 1998-2003*, which analyzed the market for CMP slurrys, pads brushes, filters, and other materials. This report contained a detailed forecast of semiconductor buildup by device category and corresponding growth in CMP operations by media planarized.

SUBSCRIPTION FORM

THE GLOBAL OUTLOOK FOR DIELECTRIC MATERIALS IN SEMICONDUCTOR DEVICES, 1999-2004

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