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FIVE TRENDS SHAPING THE FUTURE OF THE PROBE CARD MARKET

The growing demand for semiconductor ICs in personal computers, cell phones, set-top boxes, and automobiles has increased the need for reliability, safety, and wider operating ranges, thereby creating opportunities for probe card market. Probe cards enable testing of logic devices at finer pitches, higher temperatures, and increased parallelism to lower the cost of tests and increase assurance to customers that a reliable product is being delivered. The increasing

demand for integrated circuits (ICs), growth in high-frequency testing, and the increase in wafer size are driving the probe card market.

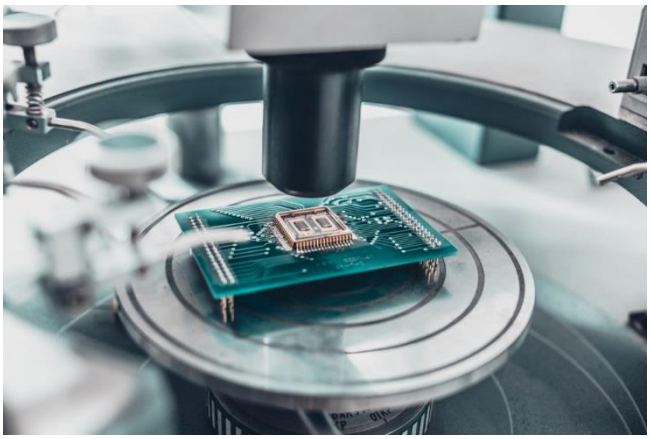
The probe card market is divided into segments of DRAM, Flash, and Foundry & Logic. Key players in the probe card market, on the product development side, include FormFactor, Micronics Japan Co., Technoprobe, Japan Electronic Materials, MPI Corporation, Nidec SV TCL, Microfriend, Korea Instrument, and TSE. These have been working on different strategies to drive sales using highly influential marketing approaches; however, as we examine the challenges and opportunities ahead in this market, companies can benefit from a strategy of pursuing advanced probe cards based on MEMS technology along with their heterogeneous integration to drive toward the key target market trends we have identified. Lucintel predicts that the global probe card market will be valued at $2.1 billion by 2025, with an expected CAGR of 3% to 5% between 2020 and 2025.

Lucintel identifies five trends set to influence the global probe card market. Most of the industry players and experts agree that these five trends will accelerate developments in the probe card industry in the near future. In terms of the widespread knowledge about the probe card market already on the horizon, there is still a lack of unified perspective on the direction the industry is moving to proactively address developments. To help bring more clarity to this gap, our study aims to provide insights concerning the direction that changes are taking and how these changes will impact the probe card market.

1. Probe Cards with Reduced Cost of Testing and High Efficiency

Various semiconductor chip manufacturers are constantly doing research to test devices seeking lower cost with better efficiency. These manufacturers report the ability to test between 8 and 256 dies in parallel, depending on die size and complexity, and probe card capabilities. To test an entire 300-mm wafer in one touchdown is technologically feasible, and a few companies are aiming to do this for memory devices in the near future. Some companies are concerned about

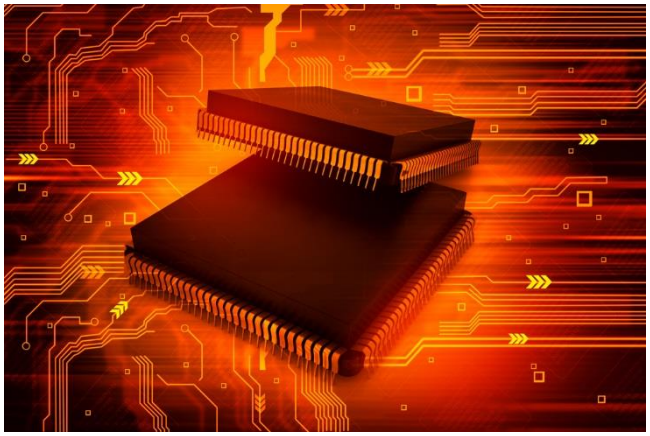
the cost of a probe card, which might not be worth the savings in test time, particularly for devices with a limited lifespan. Integrating built-in self-test (BIST) circuits into the die is one way to test more devices in parallel without increasing probe card cost, but device manufacturers are not always willing to give up real estate on the wafer. As the cost of silicon drops, this option is becoming more attractive and may enable a cost-effective full wafer test. Increasing probe life and time between cleaning can also result in cost savings. Changes in probe tip materials and geometry can minimize the amount of material sticking to the probe tips, and as a result reduce the need for cleaning; and, in one case, allow up to 300,000 touchdowns between off-line cleanings.



The industry is transitioning to sub-20 nanometer design rules to increase die per wafer and bit density. A new technology, advanced tester resource enhancement (ATRE) technology, has been initiated, which allows customers to test up to 1500 die in parallel for the lowest test cost. Its high thermal agility with reduced soak times and improved scrub performance offers ideal operational efficiency from a solo probe card and can be used over a wide temperature range. It has 3-D MEMS micro spring technology with excellent contact stability at low force, enabling probe counts of over 100,000. The test clock rates are up to 200 MHz at wafer sort, which supports customers in significantly increasing throughput and test coverage without increasing test times. The combination of performance and cost-of-test improvements enables the semiconductor manufacturer to advance their knowledge and accelerate their profitability. For instance, in 2017 FormFactor discovered SmartMatrix 1500XP, a proven solution for reducing the cost of testing. It enables testing of 25 percent more die simultaneously in a single touchdown and the increase of wafer test speeds to 200 MHz. Its robust architecture and MEMS capability have been combined with proprietary advanced tester resource enhancement (ATRE)

technology.

2. Introduction of Die Stacking for Advanced 2.5D and 3D Stacked Packages

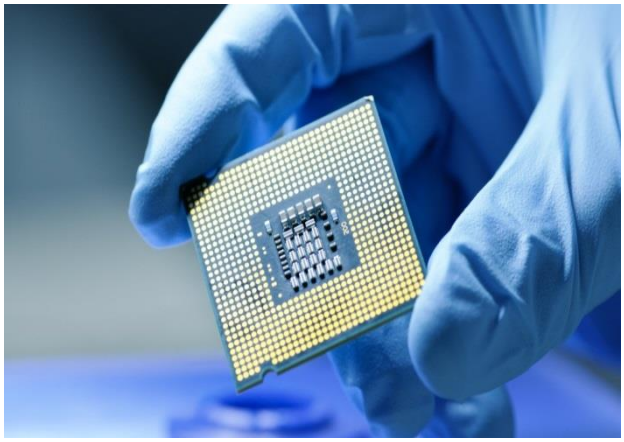


Semiconductor companies have released 3D-SIC products. These packages need multiple chip dies to be stacked vertically. This results in dense integration in an ultra-small footprint, but provides benefits in terms of performance, power, and cost. Due to its high precision, 3D-SIC manufacturing is susceptible to defects, and each IC needs to undergo electrical tests to clear out defective parts and increase product quality. 3D-SICs have complex die designs in advanced technology nodes. These must be tested using advanced test and design-for-test approaches. There are also challenges involved in die packages for 2.5D stacked integrated circuits (SICs) where the dies are placed adjacent to each other (in the same plane) on an interposer, and 3D-SIC, where the dies are stacked vertically (one on top of another).

The IMEC Research Institute has developed methodologies, including wafer probe solutions for advanced packaging technology, that utilize Through-Silicon Vias (TSVs) to stack semiconductor dies. Examples of TSV construction and micro-bump bonding, including good scanning electron microscope (SEM) images, demonstrate many of the challenges of probe.

The IMEC Research Institute worked with Cascade Microtech to develop the new “Rocking Beam Interposer” (RBI) probe technology. These probe cards contain an IC design-specific probe core, which includes a thin film with MEMS-type probe tips. Companies such as FormFactor have test solutions for copper pillar bumping and 2.5D/3D advanced packaging.

3. Rising Demand for Semiconductor ICs



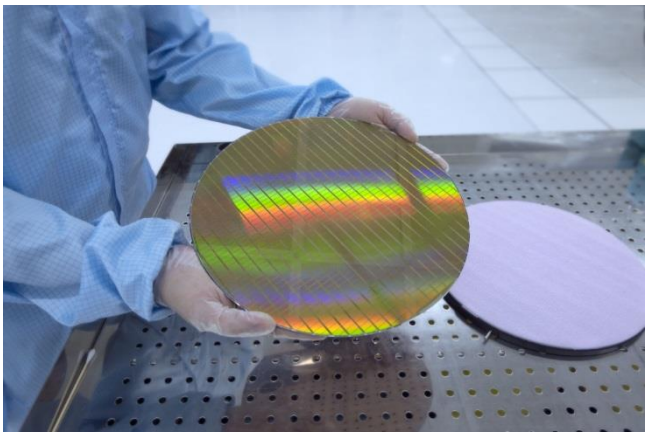
The increasing adoption of integrated circuits (ICs) for various electronic devices is triggering demand for the probe card market. There is an increasing demand for semiconductors ICs in several areas, such as servers, personal computers, automobiles, and cell phones. Therefore, various semiconductor companies prefer to focus more on design and development of their solutions, and are outsourcing their fabrication and other foundry-related activities to companies that specialize in manufacturing, assembly, and testing of semiconductor ICs. The increasing number of fabless companies results in an increase in demand for test equipment devices, such as probe cards.

Automotive electronics is the fastest growing segment in the semiconductor industry. Electronic automotive components are widely used in mid-range and entry-level cars. Large numbers of ICs are being deployed here. The trend toward the advanced driver assistance system (ADAS) in automobiles has also driven the automotive IC market, which has boosted the demand for test equipment devices in probe cards. The smartphone is the biggest application market for integrated circuits. shipments of smartphones are expected to reach 2.16 billion units in 2021, from 1.6 billion units in 2016. High population density in countries such as China, India, and Brazil, is the key reason behind the increasing rate of smartphone use. This factor is expected to curb IC market growth and so also the testing equipment such as probe cards. ICs are also used to embed Internet of Things (IoT) functionality into a wide range of systems, sensors, and objects. The growing usage of ICs in standard personal computers, set-top boxes, touchscreen tablets, and video game consoles is supporting the growth of the probe card market. It is clear

that the demand for probe cards is being driven by smart mobile devices and solid-state drives (SSDs) used in both personal computers (PCs) and enterprise data centers.

4. Increasing Size of Wafers

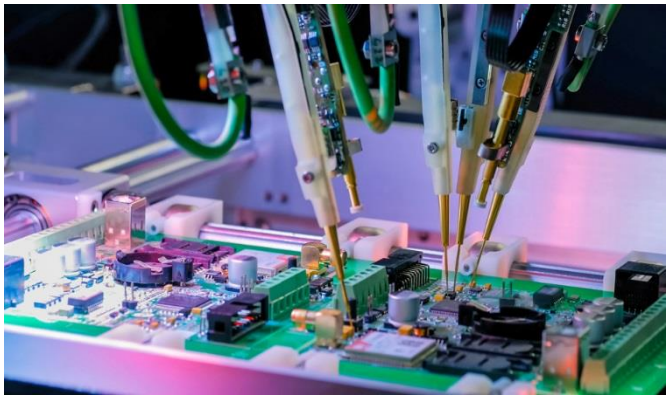
Electronic device manufacturers are continuously increasing wafer size, as increased wafer size leads to higher production efficiency and cost savings. Overall, this is preferred by implant-based electronic device manufacturers. After the development of large size wafers, the demand for large-sized probe cards has also grown. The semiconductor industry has made a significant investment in increasing wafer size, which is 300mm (11.8 times larger than 1 inch). Therefore, companies want to move toward a 450mm wafer size (1.5 times larger than 300mm). Various companies, such as Intel and Taiwan Semiconductor Manufacturing Company (TSMC), started the transition from the current standard wafer size, 300 mm, to the new 450-mm wafers. The key reason or this wafer size growth is based on three related trends: growing chip size, growing demand for chips, and the greater chip throughput (and thus lower chip cost) that the larger wafer sizes enable. The result is a 30% reduction in overall per-chip processing costs. This factor has increased the size of wafers, resulting in larger probe card size, hence boosting the probe card market.



5. Increase Demand for High-Frequency Testing

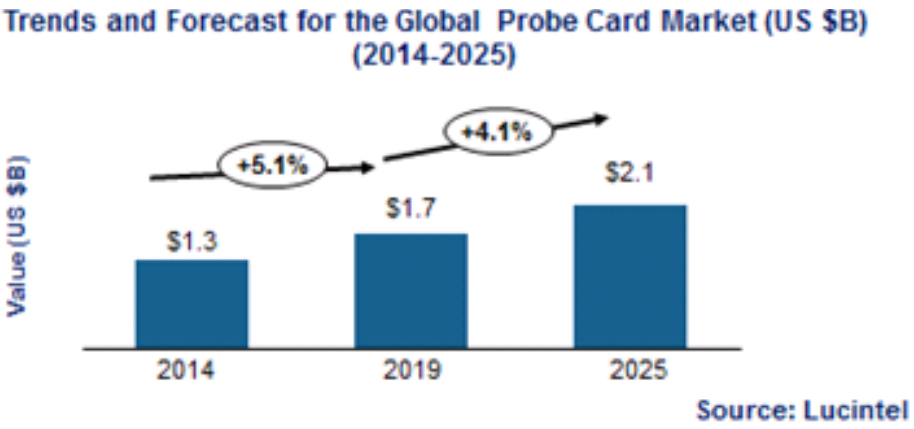
Traditional probe cards generally have poor bypassing capability at high frequencies. Nowadays, high frequency is absolutely required in a multi-probe wafer level test in RF ICs wafer sort (WLAN, Bluetooth, GPS, WiMax, and others). The growing demand for high-frequency testing

with probe cards is also driving demand for high-performance advanced probe cards. Additionally, the advanced probe card is driven by the high pin-count needs of parallel device testing and increasing volumes of high pin-count logic and SOC devices. It also reduces the signal attenuation in, and crosstalk between, probe needles during high-frequency testing. For high-frequency analog measurements and high-speed digital (1-5ns) devices, a new probing technology has emerged. These are probes with a very low capacitance and transmission line characteristics.



Strategic Considerations for Key Players in the Probe Card Market

The probe card industry is dynamic and ever-changing. Successful industry players are masters of innovation, change, and adaptation. To retain this status, they need to be attentive to current trends. We believe there will be promising opportunities for probe cards in the electrical testing of the integrated circuit in the semiconductor industry. As per Lucintel's latest market research report (Source: https://www.lucintel.com/probe-card-market.aspx), the probe card market is expected to grow with a CAGR of 3% to 5% between 2020 and 2025, and reach $2.1 billion by 2025. This market is primarily driven by the increasing demand for integrated circuits (ICs), growth in high-frequency testing, and increase in wafer size.



Whether you are new to the probe card market or an experienced player, it is important to understand the trends that impact the development process, as these trends as listed will lead players to create long-term strategy formulation to will allow them to remain competitive and successful in the long run. For example, to capture growth momentum, probe card market players can develop capabilities to match up with advanced probe cards based on MEMS technology. Players should focus on multi-site testing and die stacking for advanced 2.5D and 3D stacked packages, which are expected to lead future trends.

Note: In order to gain better understanding, and learn more about the scope, benefits, companies researched and other details in the probe card market report from Lucintel, click on https://www.lucintel.com/probe-card-market.aspx. This comprehensive report provides you in-depth analysis on market trends and forecast, segment analysis, regional analysis, competitive benchmarking and company profiling of key players. In addition, we also offer **strategic growth consulting** to meet your customized needs. We have worked with many PE firms and corporate customers in the process of their market entry and M & A initiatives.

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