

STATUS OF THE POWER MODULE PACKAGING INDUSTRY 2020

Market & Technology Report - November 2020

EVs are driving the growth of power module packaging as going to mass production of EV/HEV changes the rules of game. Technology alone is not enough, low cost is increasingly important.

WHAT'S NEW

- Update on key power module packaging trends
- Focus on SiC and GaN power device packaging
- Deep insight into power module substrates, technology trends, and supply chain
- Focus on power module packaging requirements for various applications
- Focus on China
- Impact of the COVID-19 crisis on the power electronics industry

KEY FEATURES

- Overview of the main applications for power devices, along with their drivers and future trends
- Analysis of the application trends' impact on package design and packaging materials demand
- Detailed analysis of each packaging component, along with 2019-2025 market data
- Insight regarding key technology trends
- Analysis of the power module supply chain for devices and packaging components
- Analysis of power module packaging requirements for various applications including EV/HEV, rail, motors, wind, PV and UPS
- Analysis of impact of COVID-19 on the power electronic industry
- Focus on China

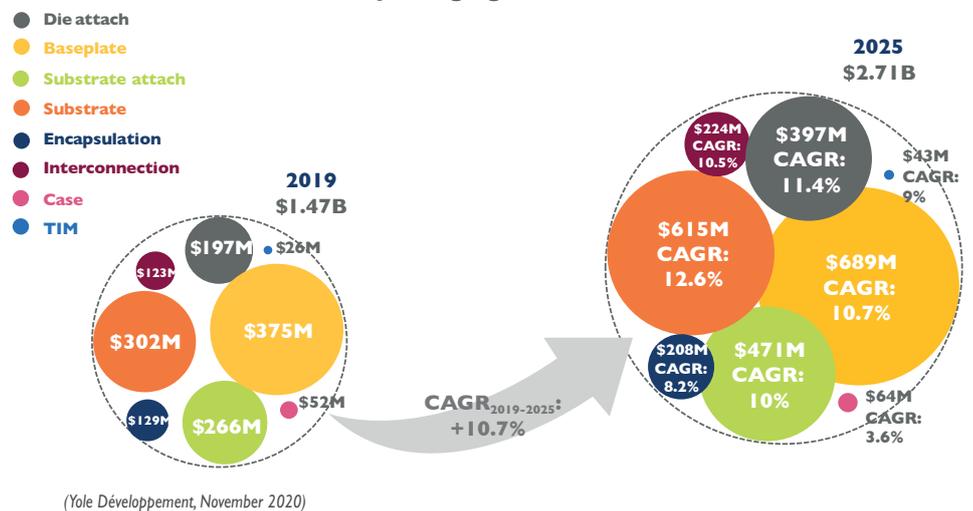
POWER MODULE PACKAGING MARKET IS GROWING AND WILL REACH AN IMPRESSIVE \$2.71B MARKET VALUE BY 2025

The power module is one of the key elements in power converters and inverters. The market for power modules will reach \$7.6B by 2025, with a 2019-2025 compound annual growth rate (CAGR) of 9.1%.

In the past, packaging needs were driven by industrial applications, but today they are increasingly driven by electric and hybrid electric vehicles (EV/HEVs). In fact, by 2025 EV/HEVs will become the biggest power module market, representing a market value of almost \$3.4B. This market's promising outlook is beneficial for the power module packaging material business, which Yole Développement (Yole) covers in this report. The power module packaging material market will achieve a CAGR₂₀₁₉₋₂₀₂₅ of 10.7%, being worth \$2.71B by 2025.

In terms of technology and market forecast, this report looks closely at substrate, baseplate, die-attach, substrate-attach, encapsulation, interconnection, and thermal interface material (TIM) markets. In 2019, the largest packaging material segment was for baseplates, followed by substrates. The next biggest market was represented by substrate-attach, followed by die-attach materials. Thus, major technological choices in these segments can rapidly impact the overall power module packaging market. For example, the market share for 2019-2025 RF GaAs die market forecast nitride as a substrate is increasing, driven especially by EV/HEVs. This technology is pricier than more conventional aluminum oxide substrates, and the CAGR₂₀₁₉₋₂₀₂₅ for substrate market is 12.6% - higher than for other market segments.

2019-2025 power module packaging market forecasts - Split by packaging solution



LINKED REPORT

Industrial Power Module Packaging Comparison 2020



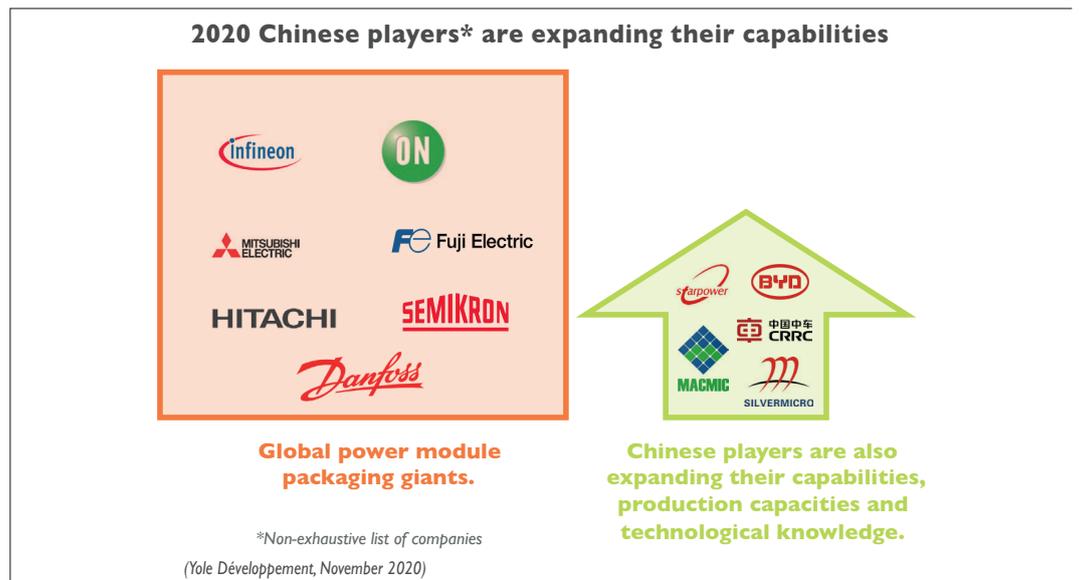
Compare the packaging technology and cost of ten industrial power modules from Infineon, Mitsubishi, IXYS/Littelfuse, Vincotech, ABB, and Wolfspeed. Bundle offer available - Contact us for more information.

INSTEAD OF EXCELLENT PERFORMANCE AND RELIABILITY, GOOD ENOUGH IS THE NEW TARGET

Although no major packaging technology breakthrough has been observed over the last several months, many technology trends from the past have been confirmed. Nowadays, as high performance and reliability targets have already been achieved by several players, differentiation is sought in another parameter, cost. With the growing manufacturing volume, every cent saved in unit cost is crucial. This change of focus explains why no major packaging

technology breakthroughs have been observed in recent months. Most players just continue improving technology by focusing on mastering manufacturing processes. COVID-19 has also negatively impacted the development and testing of new solutions due to lockdown reducing travelling and imposing working restrictions.

Today, instead of excellent performance and reliability, good enough has become the new target in power module packaging, to achieve



the cost reductions desired by customers. But to add value at lower cost is very challenging. It requires in-depth knowledge in power module

packaging materials and module designs, module manufacturing, and module integration into systems and final applications.

HOW WILL THE SUPPLY CHAIN BE IMPACTED BY THE EVOLUTION OF PACKAGING TECHNOLOGIES?

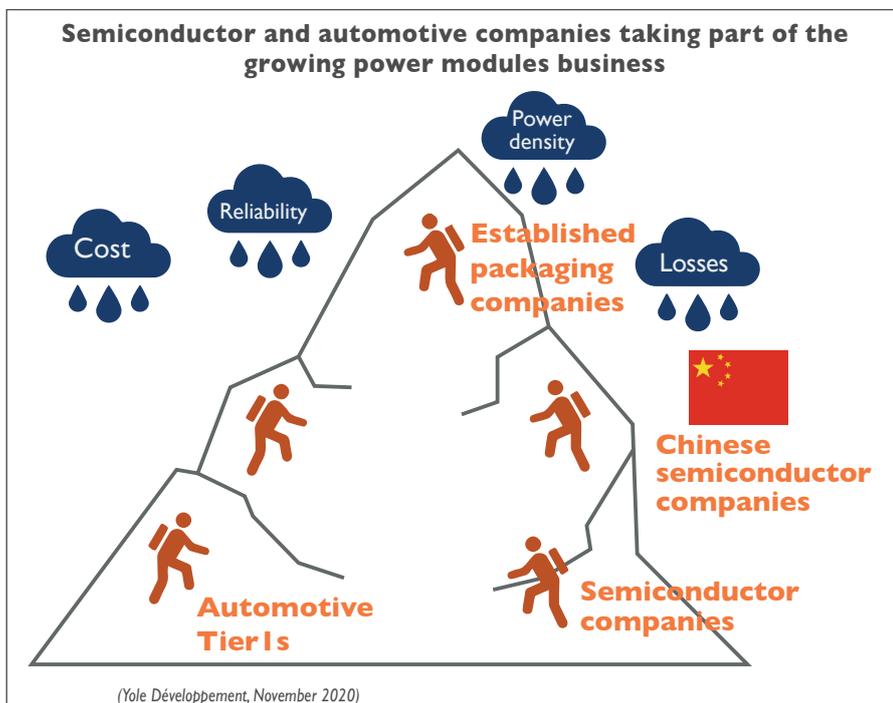
The huge business opportunity in the power device market attracts interest from different players in the power electronics and automotive supply chains. With a strong focus on power modules, changes in business models and a re-shaping of the supply chain are expected.

Automotive Tier 1 part suppliers and car making OEMs are become increasingly involved in the design and manufacturing of power modules. As power module packaging of semiconductor devices is a relatively new concept for system and car makers, it takes time to develop a power module with high performance and low manufacturing costs. Some Tier 1s and OEMs thus prefer to focus directly on newer silicon carbide (SiC) MOSFET

technology, instead of facing competition from power module makers with strong experience in already well-established silicon IGBT automotive power modules. This focus on SiC power module development has been strengthened by the adoption of SiC modules in traction inverters in Tesla Model 3 and BYD Han vehicles.

Chinese companies want to have as local a supply chain as possible. Subsidies are given by the government to support this practice. Many Chinese companies develop power module packaging solutions, mainly still using power dies supplied by European, Japanese and US companies. Most Chinese packaging companies focus on power modules for industrial applications, which are based on more conventional packaging solutions and have thus less requirements on packaging know-how. Here Chinese companies, which can often hardly compete on a technology basis, can offer cost-competitive products. However, Chinese players are moving very fast. With the help of leading material suppliers and equipment makers they are evaluating and testing different innovative solutions, such as sintered SiC dies, aiming primarily at EV/HEV applications.

Power module packaging technology is more than just about wire bonding, soldering and encapsulation. The packaging technologies, especially for applications with strong demand for power density, performance and reliability, are very complex and require specific know-how. Many newcomers in power module packaging have underestimated the packaging complexity and are struggling to bring their packaging concepts to the commercial production. Initially they targeted performance and reliability. Nowadays many players have to refocus their development



efforts on manufacturing processes and material choices in order to achieve acceptable manufacturing yield and manufacturing throughput and to reduce manufacturing costs.

External partners with the required know-how are therefore more than welcome to speed up the development and bring products to market earlier.

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REPORT OBJECTIVES

- Provide an overview of the main applications for power devices, along with their drivers and future trends
- Discuss the impact of application trends on package design and packaging materials
- Furnish an analysis of each packaging component, along with forecasts
- Identify the key technology trends that will shape the future power packaging market
- Deliver an overview of the power module supply chain for devices and packaging components
- Analyze the shifting of business models, synergies with other industries, and power device opportunities for newcomers



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RELATED REPORTS, MONITORS & TRACKS



- Power SiC: Materials, Devices and Applications 2020
- Status of the Power Electronics Industry 2020
- Power Electronics for Electric & Hybrid Electric Vehicles 2020
- Status of the Inverter Industry 2019
- Automotive Power Module Packaging Comparison 2018

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The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and Blumorpho, supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

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Bank code: 30056
Branch code: 00170
Account n°: 0170 200 1565 87
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