The power module is one of the key elements in power converters and inverters, and its market will reach $6B by 2024, with a 2018 - 2024 compound annual growth rate (CAGR) of 6.6%. In the past, packaging needs were driven by industrial applications, but today they are increasingly driven by electric and hybrid electric vehicles (EV/HEV). In fact, by 2024 EV/HEV will become the biggest power module market, representing a market value of almost $2.5B. This market’s promising outlook is beneficial for the power module packaging material business, which Yole Développement covers in this report. The power module packaging material market will achieve a 2018 - 2024 CAGR of 7.8%, reaching the $2.17B business opportunity by 2024 and representing more than one-third of the power module market.

In terms of technology and market forecast, this report looks closely at substrates, baseplates, die-attach, substrate-attach, encapsulation, interconnections, and TIM markets. In 2018 the largest packaging material segment was baseplates, followed by substrates. The other 32% was represented by die-attach and substrate-attach materials. Thus, major technological choices in these segments can rapidly impact the overall power module packaging market. For example, the market share for silver sintering as a die-attach is increasing, driven especially by EV/HEV. This technology is pricier than more conventional soldering materials, and the 2018 - 2024 CAGR for the die-attach market is +10.8% - well higher than for other market segments. The second-highest growth is for interconnections (with a 2018 - 2024 CAGR of 8.7%), followed by substrates, with a 2018 - 2024 CAGR of 8.5%.

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Although no major packaging technology breakthrough has been observed over the last several months, many technology trends from the past have been confirmed. EV/HEV applications are increasingly driving the technology trends in power module packaging, where high power density and highly reliable power module packages are needed. In parallel, the introduction of SiC technology is also pushing the development of new power packaging solutions, since SiC device can work at higher junction temperatures and higher switching frequencies with smaller die sizes. Power module packaging solutions are moving towards high-performance materials and reduction of the number of layers, size, and interfaces, while conserving electrical, thermal, and mechanical characteristics. In terms of substrate, the most common choice for power module packaging is $\text{Al}_2\text{O}_3$ DBC (direct-bonded copper). As shown in this report, the industry is moving towards materials offering better mechanical stability and higher thermal conductivity (i.e. AlN AMB (active metal brazed), $\text{Si}_3\text{N}_4$, AMB). Also, insulated metal substrate (IMS) is an alternative to ceramic
HOW WILL THE SUPPLY CHAIN BE IMPACTED BY THE EVOLUTION OF PACKAGING TECHNOLOGIES AND SPECIFIC EV/HEV REQUIREMENTS?

As analyzed in this report, two main factors will impact the reshaping of the power module packaging supply chain in the coming years: evolution of packaging technologies, and the EV/HEV industry’s specific requirements.

The evolution of packaging technologies towards innovative solutions (low-inductance interconnections, silver-sintering die-attach material, Si₃N₄ AMB ceramic substrates, etc.) will benefit the suppliers offering these solutions: for example, MacDermid Alpha, Rogers, and Toshiba Materials. Besides the materials suppliers, packaging equipment manufacturers (i.e. wire bonders, sintering machines, reflow ovens, cleaning equipment) will also be positively or negatively impacted by these changes. The power module makers that adopt innovative packaging solutions early on can secure a better market position, as seen in the example of STMicroelectronics’ SiC power module used in the Tesla Model 3’s main inverter.

Suppliers of packaging solutions for EV/HEV power modules must adapt their strategy, product portfolio, and manufacturing capacities to satisfy strong requirements in terms of costs, manufactured volume, and product reliability. This is a very challenging task, especially because many players are targeting opportunities offered via rapidly-growing EV/HEV demand. To succeed in this competitive environment, new M&A and partnerships are necessary to help capture new technologies/new customers quickly, and increase production capacity. To reduce cost pressure, some companies have already moved or are planning to move at least part of their production capacity to countries with lower production costs (i.e. China, Romania, Vietnam). Examples of such supply chain movements are provided in this report.
COMPANIES CITED IN THE REPORT (non exhaustive list)


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