Toshiba and Global Power Technology accelerate SiC power device patent filings

Over 840 new patent families filed globally in Q1/2025, says Knowmade.

According to data from the SiC Patent Monitor of technology intelligence and IP strategy consulting company KnowMade, power silicon carbide (SiC) technology saw robust patenting activity in first-quarter 2025, with over 840 new patent families filed globally.

The patenting activity is marked by the acceleration of Toshiba in the SiC power device patent landscape, totaling the same number of new inventions as that disclosed by Chinese company Global Power Technology in Q1/2025. The latter has been a regular top patent applicant in the last four quarters, focusing almost exclusively on the design of SiC MOSFET structures.

Interestingly, more than 420 patent families were granted for the first time during the last quarter. The ranking of patent assignees highlights five Japanese companies (Denso/Toyota, Fuji Electric, Sumitomo Electric, Mitsubishi Electric) alongside the prominent Chinese contender Global Power Technology, whose position is due to a high number of utility models registered during the same period. Meanwhile, over 120 patents expired or were abandoned during the quarter, nearly 20% of which originated from Wolfspeed.

The quarter also saw about 40 patent transfers, with several patent reassignments from Qorvo to United Silicon Carbide following its acquisition by onsemi in January. Furthermore, collaborative IP activities exceeded 15, predominantly national partnerships between research institutes and domestic enterprises, although the cross-border Nissan–Renault alliance targeting enhanced gate reliability of trench SiC MOSFETs (featuring an electric-field relaxation region beneath the gate trench) stood out.

No new patent litigation was identified in the SiC landscape in Q1/2025. Instead, a US litigation case between Purdue University and Wolfspeed concluded. The SiC patent landscape welcomed over 15 newcomers in Q1/2025 (i.e. entities publishing their first SiC-related patents), most of them coming from China. Finally, four key IP leaders — Rohm Semiconductor, Wolfspeed, Toshiba and STMicroelectronics — have been identified for in-depth analysis in the latest quarterly report of Knowmade's SiC patent monitoring service.

Main IP players driving the IP activity in each segment of the supply chain have been identified according the number of their new patent families (inventions) published during the quarter

Notable innovations across the silicon carbide supply chain

SICC remains one of the most prolific patent applicants in the SiC substrate patent landscape and is still among the few Chinese companies seeking patent protection for SiC innovations outside China. Its recent PCT applications target enhanced crystal quality by reducing the residual internal stress and by achieving a more uniform stress distribution across large-diameter SiC wafers.

Microchip Technology has resumed its patenting activity in the SiC power device patent landscape, disclosing three inventions related to a SiC/Si hybrid channel power MOSFET to provide for increased carrier mobility and other potential benefits in terms of switching losses, power density etc. Meanwhile, Purdue University this quarter introduced a SiC MOS-based power device with ultra-short channel lengths, having ultra-low specific on-resistance.

Diving into next-generation SiC devices, Knowmade's Q1/2025 report highlights companies publishing new patent applications targeting SiC superjunction structures (Rohm, Toshiba), SiC JFET (onsemi) and SiC IGBT (Hitachi, GlobalFoundries, Rohm, Toshiba). In a newly published patent application, Hitachi considers the use of semi-insulating SiC substrates for medium-voltage (MV) applications (>10kV), with a view to reducing manufacturing costs of the corresponding SiC devices (e.g. a PiN-diode or an IGBT).

Moreover, the integration of SiC devices into MV power modules (e.g. 15kV) has been considered in a new patent publication from Aalborg University, aiming to reduce the maximum electric field in the trench between high-voltage and ground pads (a reduction in the triple-point maximum electric field).

Notable companies have published new patent applications in the module and packaging space this quarter, such as onsemi (flip-chip and pre-molded clip power modules), Hitachi (die-attach featuring high bonding reliability at high temperatures) and Semikron Danfoss (three-level power module having low-inductance layout).

Down the SiC supply chain, patenting activity related to circuits and applications remained quantitatively dominated by Chinese research organizations in Q1/2025. Notable patent applications relate to SiC device implementation in different application fields such as EV/HEV (e.g. controlled active DC bus discharge, Allegro Microsystems), offroad vehicles (e.g. portable MW charging systems, Caterpillar), space or nuclear applications (e.g. measurement systems, Hitachi), and energy storage (e.g. grid-connected battery systems, Siemens). ■

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