

Thrilling Compound Semiconductor business opportunities in China

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Abstract

As compound semiconductor markets in Power and RF segments emerge rapidly, investments in Power SiC, Power GaN, RF GaN and RF GaAs businesses pace around the world over the last years. Undoubtedly all industry eyes are on China. In the last few years, numerous Chinese players have been swiftly getting ready to compete on the global compound semiconductor stage through tremendous investments, merger and acquisitions as well as partnerships. This paper provides an overview of Chinese SiC, GaN and GaAs ecosystems in RF and power applications, including Yole Développement’s understanding of the market’s current dynamics and future evolution of business opportunities.

INTRODUCTION

Thanks to high GDP, large domestic end-market size, and capital resources, China holds a great market opportunity for both semiconductor players and investors in market segments from consumer, automotive to industrial. As an emerging part of the semiconductor industry, compound semiconductor business shows the same momentum for Chinese actors.

Over the last decade, many factors lead to a boost in development and evolution of Chinese ecosystem build out: the “New Infrastructure Construction” roadmap, trade tensions with the USA, governmental incentives and high capital resources, cost-competitive policy, high volume domestic market.

Power and RF electronic markets have been very dynamic with main mega trends such as electric and hybrid electric

vehicles (EV/HEV), energy storage and conversion with increasing digitalization, 5G network installations, connectivity etc.

In order to benefit from emerging market opportunities, players from different regions of the world from different technology areas (material and equipment suppliers, power electronic device manufacturer, system integrators, car makers...) are entering or investing significantly. Similar to global movements, China is also building its own compound semiconductor ecosystem and getting ready for the next wave of market growth.

POWER SiC AND POWER GaN MARKETS

The wide band gaps SiC and GaN are considered one of the most promising technologies in the scale of “3rd generation semiconductor. Driven by vehicle electrification and rapid charging applications, both wide gap materials have witnessed a rapid growth over the last years. Looking into the future, both markets are expected grow with double digit CAGR with entry of IDMs, foundries, wafer and epiwafer supplier globally.

In Chinese power electronics ecosystem, several projects worth several billions of US dollars were announced in 2020-2021 for wide band gaps. For example, leading Chinese n-type SiC supplier Tankeblue announced investment of over \$140M to expand its 6” SiC production capacity. Similarly, SICC, Synlight, and CZSC have announced plans to build new SiC wafer production lines/fabs. In addition, Hunan Sanan Semiconductor, wholly owned subsidiary of Sanan Optoelectronics, invested \$2.5B to open China's first

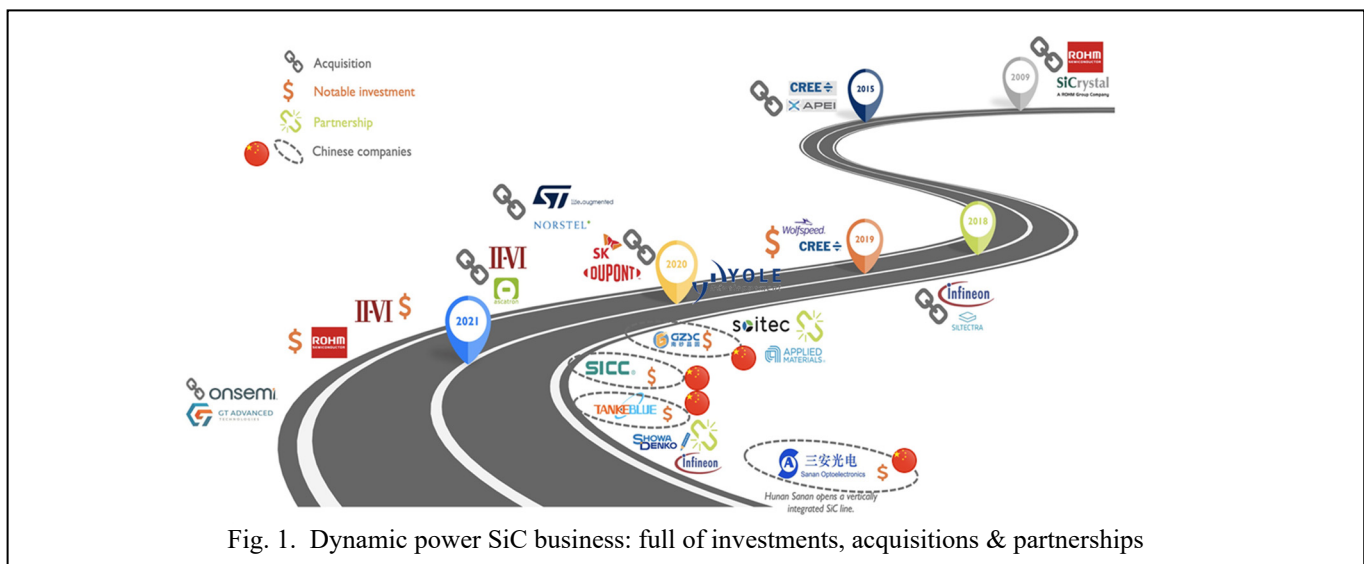


Fig. 1. Dynamic power SiC business: full of investments, acquisitions & partnerships

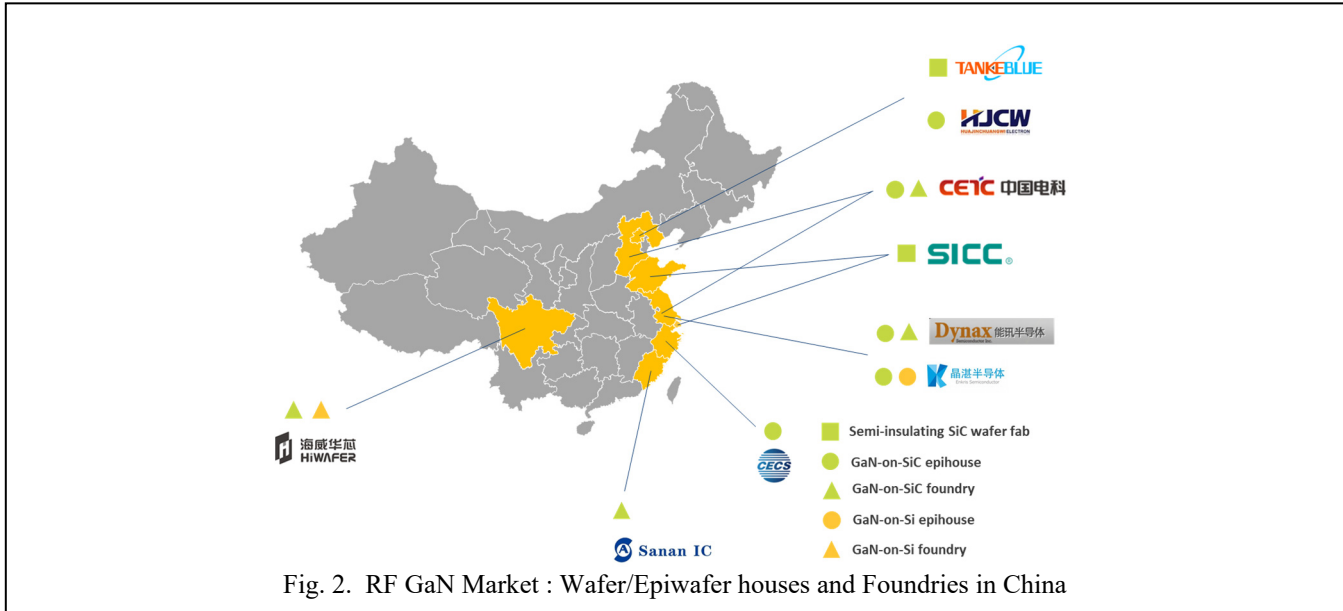


Fig. 2. RF GaN Market : Wafer/Epiwafer houses and Foundries in China

vertically integrated SiC production line, in addition to power GaN manufacturing line.

At the end system level, China also hosts large automotive and consumer domestic markets. Indeed, several smartphone OEMs such as Oppo, Vivo, Xiaomi, Realme and Meizu rushed to adopt GaN-based in-box fast charger for their flagship released in 2020-2021. Chinese automotive OEMs BYD, Nio, BAIC, Xpeng and many others have also opted for SiC technology in their next generation EV models.

RF GAN AND RF GAAS MARKETS

Driven by 5G network build out, both GaN and GaAs technology platforms are well positioned to address the demand from low power to high power from sub6GHz to mm-wave regimes. While GaN RF finds its growth in high power 5G remote radio heads (RRH) and active antenna systems, GaAs remains as the building block of RF front-end modules in smartphones.

Within the RF GaN ecosystem, China's Huawei started using these devices in its 4G LTE RRH in already in beginning of 2010s. The telecom behemoth had decided to trade low-cost Si LDMOS for GaN's high power density and wide bandwidth, and other OEMs followed. As of today, in view of US sanctions related to Huawei and ZTE, OEMs have been putting pressure on the domestic value chain and investing heavily in the Chinese ecosystem. Many Chinese actors have developed GaN RF technology as cited in Figure 2. For example, at the substrate level, Chinese companies SICC, Tankeblue and Synlight supply S.I. SiC wafers. Dynax Semiconductor has commercial products for the 5G market, foundry Sanan IC is expanding its portfolio. In addition, Chinese state company CETC has already developed GaN-based military radar from substrate to system.

GaAs RF ecosystem is also in construction following the US-China trade war, one of the major smartphone OEMs,

Huawei has been building its own local value chain. For example, for the Mate series: HiSilicon and Sanan IC are supplying the 5G PA. In addition, China-based Vanchip technology, invested by MediaTek and also Chinese smartphone OEMs, began shipping 5G PA to Chinese OEMs such as Xiaomi, OPPO, Vivo...etc.

CONCLUSIONS

In the frame of the "New Infrastructure Construction" roadmap, the Chinese compound semiconductor industry is undergoing a tremendous build out from raw materials to system level. Similar to other regions of the world, China is also keeping up with the emerging growth of GaN, SiC and GaAs technology platforms. Multibillion US dollar investments and capacity expansions multiple each quarter, and Chinese players desire to grab a bigger share in the global market.

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ACRONYMS

- EV/HEV: electric vehicles/ hybrid electric vehicles
- BEV: battery electric vehicles
- LTE: Long-term evolution
- CAGR: Compound Annual Growth Rate
- OEM: original equipment manufacturer