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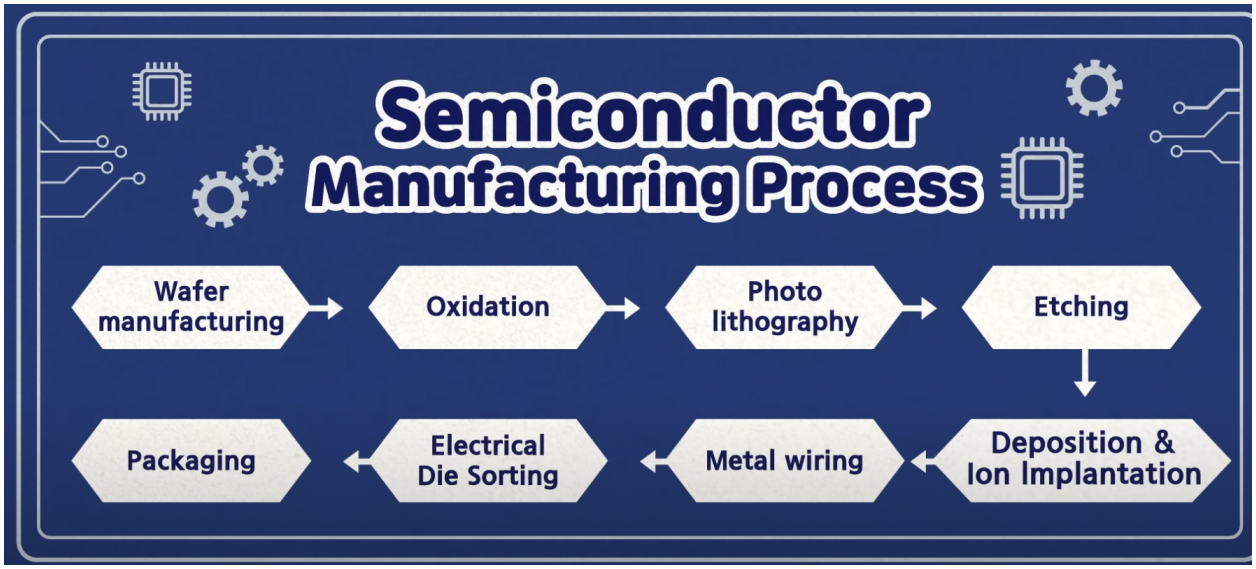
The present and future semiconductor industry, packaging

Over the past several decades, engineers have been at the forefront of innovation, working to bring forth cutting-edge technologies such as AI, autonomous vehicles, and smartphones. These advanced products are heavily reliant on semiconductors, which play a critical role in powering the complex computations required for their operation. Without high-quality chips, these systems would not function optimally and fail to deliver their intended results. In other words, the semiconductor industry is the fundamental industry that can help engineers accomplish their goals. Then, how is the semiconductor made and what is the packaging? Samsung and ASML, semiconductor manufacturing companies, introduced the eight main steps of making semiconductors from sand.



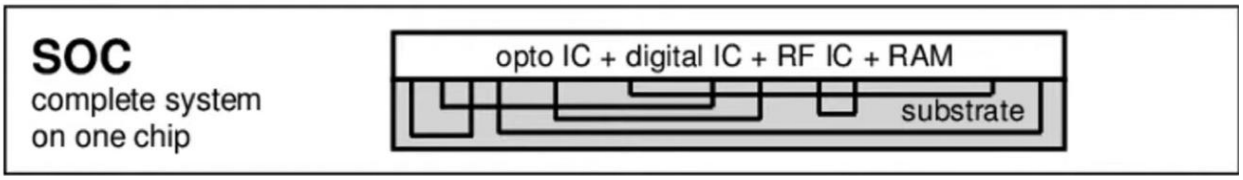
<Fig 1. Semiconductor Manufacturing Process>

The first step in the semiconductor manufacturing process is the extraction of the ingot, a large circular pillar made of silicon which is the main ingredient of semiconductors due to its electrical properties. The ingot is then sliced into wafers, which will be given a protective layer of SiO2. Next, tiny circuits are drawn on the wafers at a scale of nanometers and the material is ionized to enhance its electrical properties. These wafers are then cut into even smaller chips. The final step

in the process is packaging, which serves to protect the chip from external damage, check its electrical performance, and meet dimensional requirements (Timings, 2021).

Why packaging has become so important nowadays?

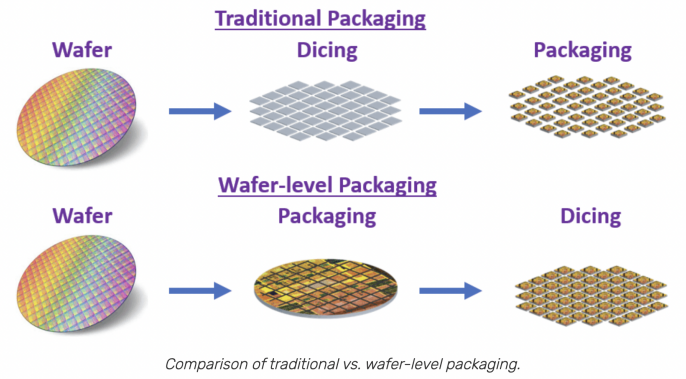
Packaging has become increasingly important in recent times due to advancements in technology. With the development of complex computations and larger batteries, there is a growing need for more components in products. For example, companies have started to explore innovative methods of chip stacking and arrangement, in order to save space and reduce energy waste. In the 1970s, the traditional single-die packaging method, which consisted of a single die in a package, was widely used. However, as society demanded more functionality in smaller spaces, engineers developed the System on Chip (SoC) technology. This innovative solution embeds the entire system on a single chip and has become a widely adopted method in the industry, such as Qualcomm Snapdragon. SoC not only reduces the space required for the system but also reduces energy waste and costs.



<Fig 2. Image of System on Chip from Physical Design for 3D System on Package>

What is the current technology?

With numerous companies competing to develop cutting-edge packaging technologies, there are now various types of packaging available in the market. One of the companies that has made remarkable advancements in this field is Taiwan Semiconductor Manufacturing Company (TSMC). TSMC has achieved great success by incorporating Fan-out Wafer Level Packaging (FOWLP) technologies into its products. To understand the significance of this technology, it's important to know about Wafer-Level Packaging. Unlike the traditional method, where the packaging was done after cutting the wafer into chips, Wafer-Level Packaging involves applying the packaging on the entire wafer before cutting it into individual chips. This approach has two key advantages - improved signal integrity and the ability to carry out reliability and testing processes at the wafer level.



<Fig 3. Comparison of traditional packaging and Wafer-Level Packaging>

Fan-Out Wafer Level Packaging (FOWLP) is one of the Wafer-Level Packaging types.

In conclusion, the semiconductor industry plays a crucial role in supporting the advancements in technology such as AI, autonomous cars, and communication technologies. The importance of packaging in this industry has increased as the need for more components and functionality in smaller spaces has grown. Companies such as TSMC have made great strides in this field by incorporating FOWLP technologies into their products. With the advantages of improved signal integrity, the ability to perform reliability and testing processes at the wafer level, and reduced energy waste and costs, it is clear that packaging will continue to play a critical role in the semiconductor industry for years to come.

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