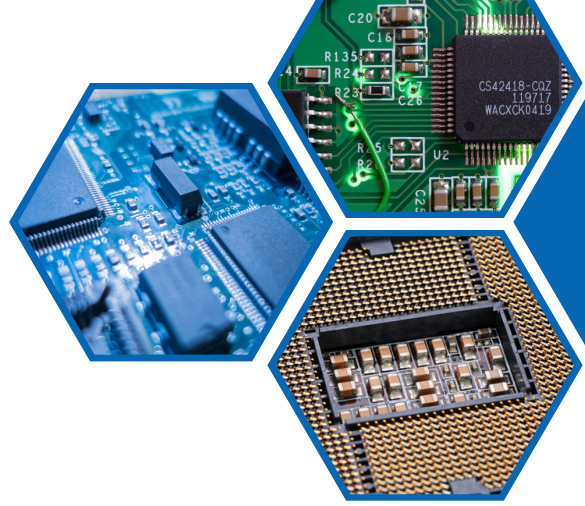


# Graphite in Semiconductors



## Overview

Semiconductors are at the heart of modern electronics, crucial for a vast array of devices from everyday gadgets to sophisticated industrial equipment. In 2020, over 1 trillion microchips were manufactured globally, underlining the immense scale of this industry. However, Europe accounts for only 10% of global semiconductor sales, highlighting the need for growth to reach its target of 20% by 2030.

## Semiconductor Manufacturing Processes

The production of semiconductors is a complex, multi-step process, essential for creating high-quality wafers used in electronic devices. Ultra-pure graphite equipment is indispensable in supporting silicon wafers throughout their production.

### Silicon Crystal Growing

The Czochralski (CZ) method, a technique developed in 1916, is used to grow single crystal silicon, a fundamental material for semiconductors and solar cells. High Purity Treatment Graphite is vital in this process for maintaining a clean environment essential for quality crystal growth.

### Epitaxial Growth

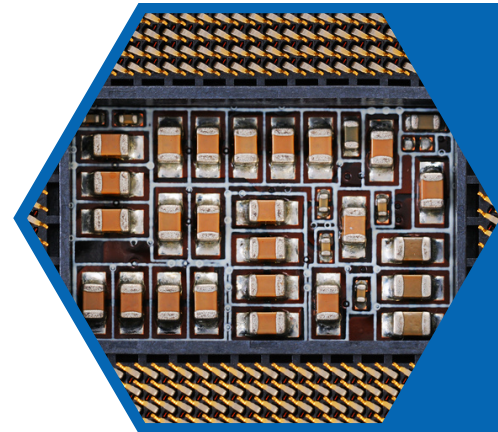
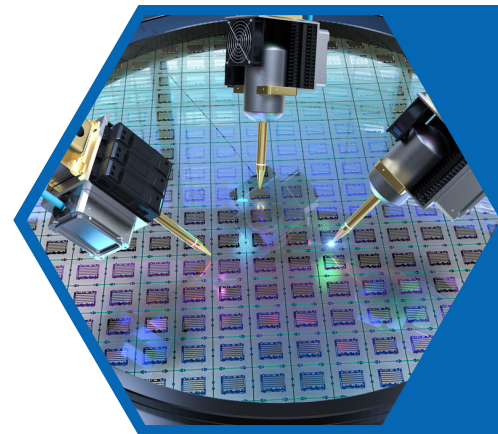
This technique, crucial in the semiconductor industry, involves growing semiconductor films epitaxially on semiconductor substrate wafers. High-strength isostatic graphite susceptors are used to carry the wafers, significantly impacting the quality of the wafer's epitaxial layer.

### Ion Implantation

This method modifies the composition and physical properties of a substrate, with graphite playing a key role in maintaining beam purity and process stability.

### Metal Organic Chemical Vapor Deposition (MOCVD)

A versatile technique used for the growth of various semiconductor films. It relies on graphite for successful operation, underscoring graphite's importance in semiconductor technology.



# Graphite in Semiconductors

## Graphite in Semiconductor Tooling

**Graphite, particularly isostatic graphite,** is essential in semiconductor tooling due to its:

- High thermal and chemical resistance.
- Excellent thermal shock resistance and electrical conductivity.
- Increasing strength with temperature.
- Easy machinability and ability to be produced with very high purity.

## Graphite Demand and Semiconductor Market

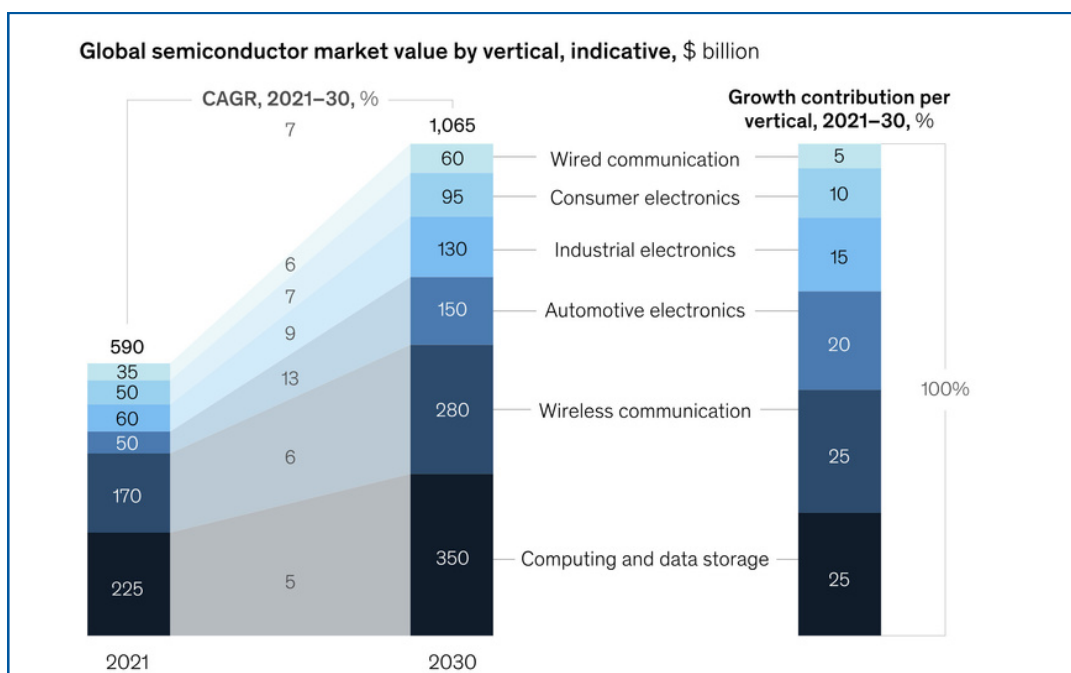
In 2022, Europe's demand for isostatic graphite for semiconductor production was approximately 3000 tons, distributed across various stages including polysilicon production, silicon crystal production (CZ), chip production, and SiC-wafer production.

The global semiconductor market size was USD 527.88 billion in 2021 and is projected to grow to USD 1380.79 billion by 2029, with a CAGR (Compound Annual Growth Rate) of 12.2%.

The automotive, computation and data storage, and wireless industries are expected to be the major drivers of this growth.

## Semiconductors Industry

### The semiconductor decade: A trillion-dollar industry



**The overall growth in the global semiconductors market is driven by the automotive, data storage, and wireless industries.**

Note: Note: Figures are approximate.

Source: McKinsey&Company