

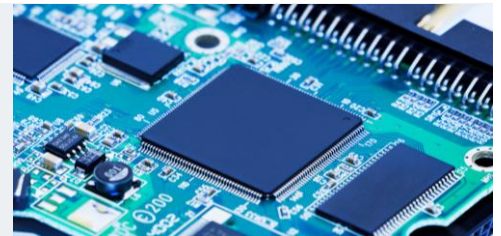
Global market to reach the order of 100 trillion yen by 2030*.
"Semiconductors" will be the foundation of our lives in the future,
including the spread of 5G, AI, and connected cars.

The Mitsubishi Chemical Group offers a wide range of products and services associated with the semiconductor industry.

Demand for semiconductor devices is increasing every year against the backdrop of changing lifestyles, greater data communication volumes owing to the spread of 5G, AI, and IoT, and the growing number of connected cars. The global semiconductor market came in at just under 20 trillion yen in 2001, but is expected to exceed 70 trillion by 2025 and reach 100 trillion by 2030*.

[*2021 Ministry of Economy, Trade and Industry, 1st Semiconductor and Digital Industry Strategy Review Conference Document, "The Global Semiconductor Market and Its Major Players"](#)

Global semiconductor market

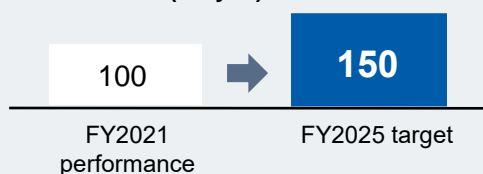


The Mitsubishi Chemical Group (the MCG Group), Japan's largest chemical manufacturer, aims to be the global leading specialty materials group and has identified the EV/Mobility, Digital, and Food markets as focus markets based on major global trends.

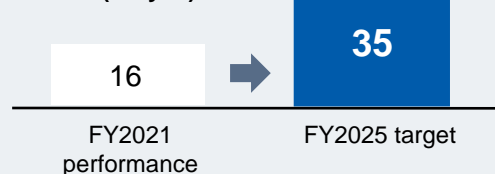
We are targeting sales of 150 billion yen in FY2025 in the area of semiconductors, the core of our digital business. The MCG Group works with semiconductor manufacturers and other customers to provide solutions to their challenges, and supports semiconductor manufacturing through innovative solutions. In this newsletter, we would like to showcase the products and services that MCG Group provides in the semiconductor field.

The Mitsubishi Chemical Group in the semiconductor field

Sales revenue (Bn yen)



EBITDA (Bn yen)



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- **The MCG Group's key products and services for semiconductor manufacturing processes**
Along with an explanation of the semiconductor manufacturing process, we would like to show where the MCG Group's products and services are being used.
- **Products and services related to front-end processes in semiconductor manufacturing**
- **Products and services related to back-end processes in semiconductor manufacturing**
- **Products and services used throughout semiconductor manufacturing processes and other operations**

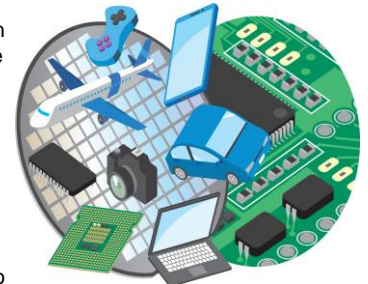


What are semiconductors?

Semiconductors, with silicon being a typical example, are materials that fall between "conductors" that conduct electricity and "insulators" that do not.

These materials, although not normally conducting electricity, have conduction properties that allow them to conduct electricity or make them less conductive depending on conditions. Today, electronic components developed using these characteristics are widely referred to as "semiconductors."

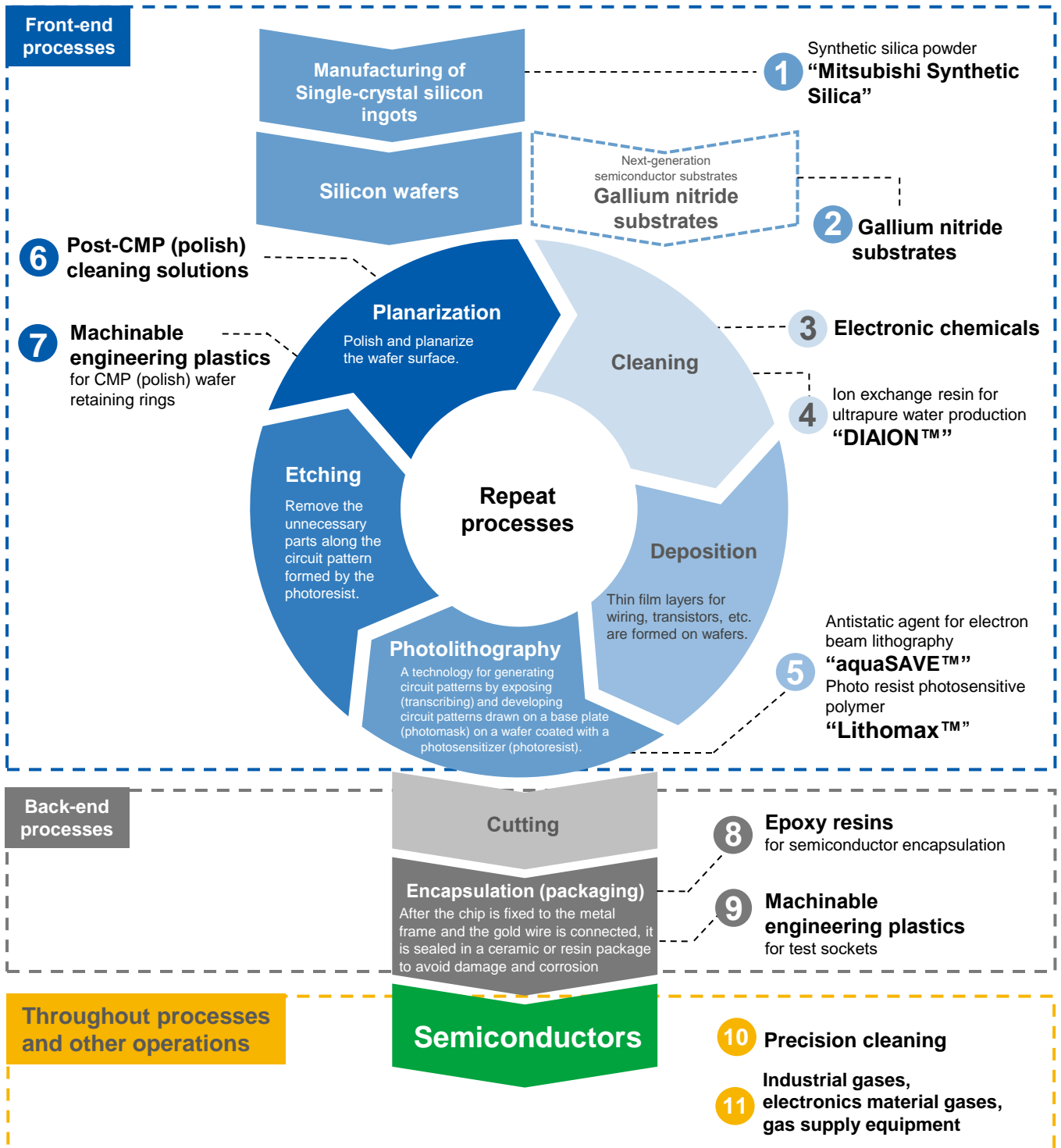
Of these products, major semiconductor components include ICs (integrated circuits), LSIs (large-scale integrated circuits), and storage devices (memory chips), which are used in a variety of products such as smartphones, PCs, automobiles and home appliances, and are essential to social life as the foundation of industry.



The MCG Group's key products and services for semiconductor manufacturing processes

The semiconductor manufacturing process is divided into two general processes: front-end and back-end. In the front-end process, electronic circuits are formed on silicon wafers, and in the back-end process, semiconductor chips are cut from the silicon wafers and fixed and encapsulated (packaged) into products.

1 - 11 : The MCG Group's products and services

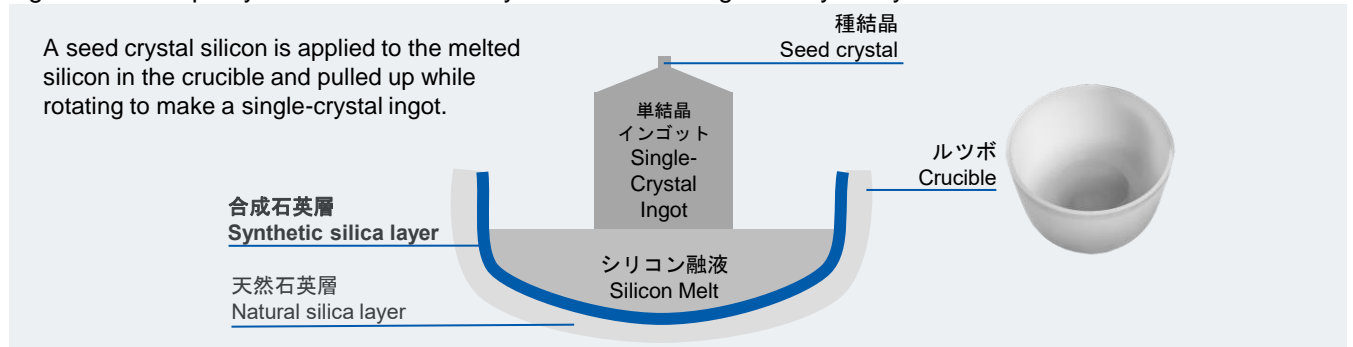


The MCG Group's products and services related to front-end processes in semiconductor manufacturing

[1] Synthetic silica powder "Mitsubishi Synthetic Silica"

Synthetic silica powder is a material used on the interior of silica crucibles used in the manufacture of high-purity monocrystalline ingots, which are the basis of silicon wafers.

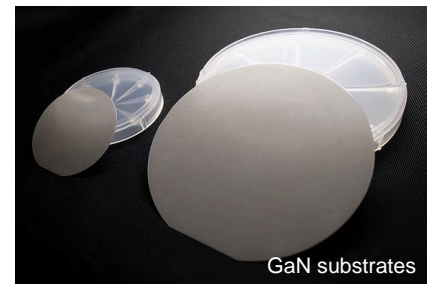
An extremely high level of purity is required for this material, as impurities in ingots have a significant effect on the quality of silicon wafers. Thanks to our proprietary manufacturing process, "Mitsubishi Synthetic Silica" provides the highest level of purity in the world for sandy silica and is being used by many customers.



[2] Gallium nitride substrates

Gallium nitride (GaN) substrates are expected to be used in power semiconductors, next-generation EVs, and 5G as materials that enable ultra-high-efficiency devices with faster operation and lower resistivity and lower power loss than silicon-based devices.

With our newly developed acidic ammonothermal technology, "SCAAT™," we have achieved higher quality levels compared to conventional GaN substrate production methods. Furthermore, in order to improve productivity, we have developed low-pressure acid ammonothermal technology in collaboration with Tohoku University and The Japan Steel Works, Ltd. (JSW). Starting in May 2021, we have been conducting demonstration tests for GaN substrate mass production using the new, productivity-improved "SCAAT™-LP" manufacturing technology jointly with JSW, and plan to begin supplying samples in the second half of FY2023.



[3] Electronic chemicals (EL chemicals)

EL chemicals are used to remove impurities and debris from silicon wafers. The purity of these wafers needs to be extremely high because impurities and particle can cause short circuits and other problems that prevent semiconductors from functioning.

The MCG Group addresses these requirements by employing refining technologies that achieve a metal impurity content of no greater than 0.01 ppb (1/100 billion), analytical technology with cutting-edge performance in checking for impurities, and quality control technology for delivering products to customers without compromising these high levels of purity.

[4] Ion exchange resin for ultrapure water production "DIAION™"

The cleaning process is said to account for 30% of the semiconductor manufacturing process, and the water used in this process is "ultrapure water," or water from which impurities have been eliminated to extreme limits.

One essential component for the production of ultrapure water is ion exchange resins.

The MCG Group offers a full line of high-grade ion exchange resins for use in various units employed in ultrapure water production systems.

In particular, our resins for final polisher applications deliver the highest levels of quality in the industry, and are being used by many semiconductor manufacturers.

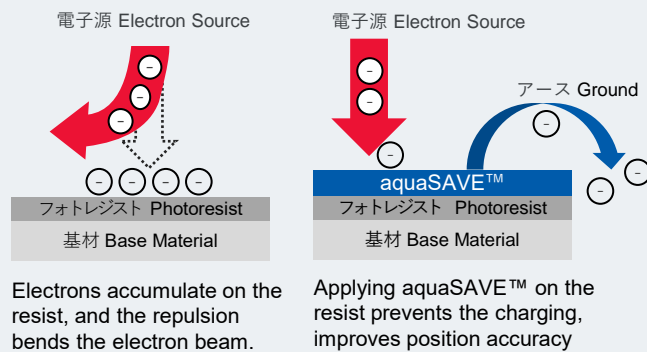


The MCG Group's products and services related to front-end processes in semiconductor manufacturing

[5] Antistatic agent for electron beam lithography "aquaSAVE™" Photo resist photosensitive polymer "Lithomax™"

"aquaSAVE™" is a water-soluble antistatic agent used to etch circuit patterns on photomasks. It is highly conductive and compatible with photo resists. "Lithomax™" is a photosensitive polymer used as a resist for printing circuit patterns on wafers and is characterized by its extremely low metal content and level of impurities. Today, circuit patterns are becoming increasingly finer, which requires ever-higher performance levels of these products. We offer products that meet these requirements, and they are being used by major resist manufacturers around the world.

Effects of aquaSAVE™



How Photolithography Works

By covering the area with a photomask and then exposing it to light, the photoresist in the area exposed to the light turns into a soluble form, which can be used to create various circuit patterns.



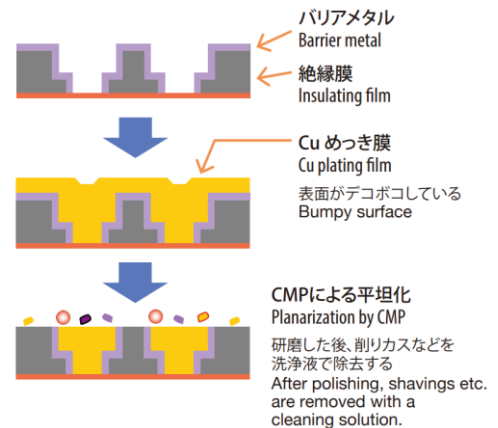
[6] Post-CMP (polish) cleaning solutions

As the number of layers of interconnects on wafers increases, planarizing the interconnect surfaces layer by layer has become increasingly important. Post-CMP (polish) cleaning solutions are used to remove shavings and residue generated during CMP and require high cleaning performance. That being said, foreign matter needs to be removed without affecting the interconnects.

The MCG Group has achieved both of these cleaning characteristics—"high cleaning performance" and the "ability to remove foreign matter without affecting interconnects"—and continues to maintain high levels of quality through customization to meet the requirements of each individual customer, and by making repeated evaluations and improvements.

CMP Process

Chemical Mechanical Polishing (CMP) is the process of polishing by using chemical and physical actions.



[7] Machinable engineering plastics for CMP (polish) wafer retaining rings

Mitsubishi Chemical Advanced Materials, a member of the MCG Group, offers the lineup of "Techtron™ 1000PPS," a machinable engineering plastic material that is suitable for retaining rings that hold wafers during the CMP process.

"Techtron™ 1000PPS" offers precise machining tolerance, low wear rates, and chemical resistance over a wide range.

"Techtron™ 1000PPS" enables planarization and polishing over extended periods of time in the CMP process, making it a useful option for semiconductor manufacturers.

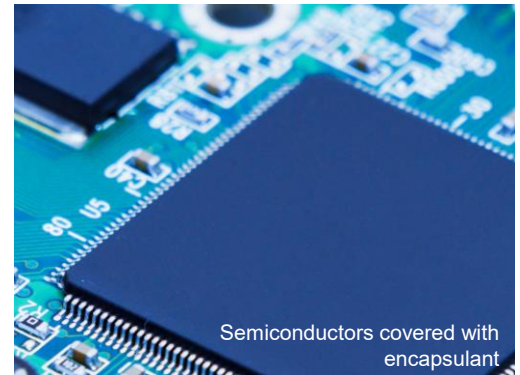


CMP (polish) wafer retaining rings

The MCG Group's products and services related to back-end processes in semiconductor manufacturing

[8] Epoxy resins for semiconductor encapsulation

Epoxy resin is a generic term that refers to synthetic resins having an epoxy radical. These are thermosetting resins that harden when heated and can be given various characteristics depending on the hardener and the types and blends of compounds that they are combined with. They have very strong adhesive properties and are used as adhesives for metals, porcelain, and concrete. They also have excellent insulating and water resistance properties, and are resistant to heat and chemicals, making them an ideal material for electronic devices. Thanks to these properties, they are an essential material for making encapsulants that cover semiconductor chips and protect them from dust, heat, moisture, shock, and other environmental elements.



Semiconductors covered with encapsulant

Epoxy resins developed based on the MCG Group's molecular design capabilities combine the physical properties required of encapsulants, including resistance to heat, water, and shock, with a good balance of flowability, making them the de facto standard* of semiconductor encapsulants worldwide. They are also used in solder resist ink for protecting semiconductors and in the underfill that protects semiconductor chips and secures them to substrates, making them an essential material for semiconductors.



Epoxy resins for semiconductor encapsulation

In April 2023, we completed a new production line at the Kyushu Plant to meet increasing demand. Building on our experience of producing Japan's first epoxy resin in 1962, we are committed to continue providing high-quality epoxy resins.

* De facto standard

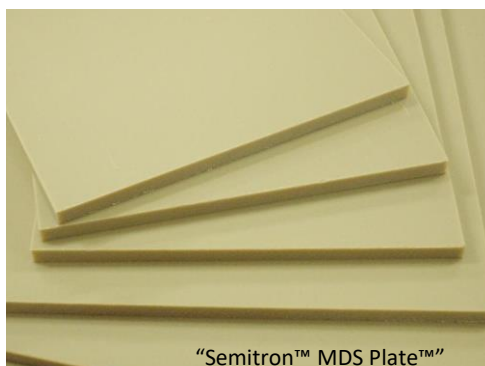
This refers to standards that, unlike standards set by standardization organizations such as ISO or JIS, were effectively standardized as a result of market competition.

[9] Machinable engineering plastics for test sockets

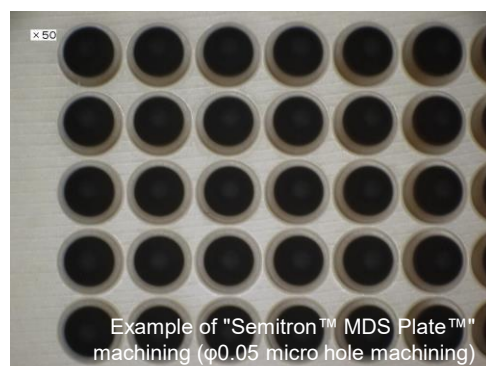
After semiconductors are finished, test sockets are used to inspect their electrical and other characteristics.

Mitsubishi Chemical Advanced Materials, a member of the MCG Group, offers the lineup of "Semitron™ MDS Plate™," a machinable engineering plastic material for test sockets.

This material provides excellent dimensional stability and micro-machinability, and is being used for inspection sockets as the circuit patterns on semiconductor devices become increasingly finer. "Semitron™ MDS Plate™" supports semiconductor device manufacturers in the area of resin material for test sockets in developing high-precision inspection systems.



"Semitron™ MDS Plate™"



Example of "Semitron™ MDS Plate™" machining (φ0.05 micro hole machining)

The MCG Group's products and services used throughout semiconductor manufacturing processes and other operations

[10] Precision cleaning

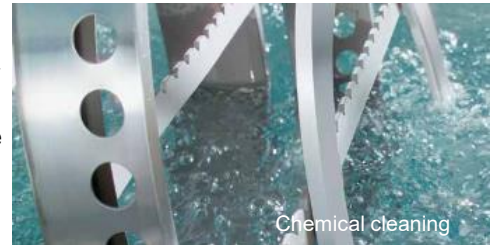
The MCG Group offers cleaning services for parts used in semiconductor manufacturing equipment.

[1]Cleaning product parts for manufacturers of semiconductor manufacturing equipment

[2]Cleaning equipment parts that got dirty in the manufacturing process of semiconductor device manufacturers

These two channels make up the foundation of our business.

At the MCG Group, we leverage our comprehensive capabilities to offer a variety of solutions to issues associated with the cleaning of parts in cutting-edge semiconductor processes. We are the only company in the world with a global presence, with offices in Taiwan, Korea, and China, which are centers of semiconductor device manufacturing, as well as in Japan, Europe, and the United States.



[11] Industrial gases, electronics material gases, gas supply equipment

Semiconductor plants use an extremely diverse range of gases.

Typical examples include ultrapure nitrogen and argon gas, as well as hydrogen, helium, and electronics material gases such as B_2H_6 , which are essential in the manufacture of a wide range of semiconductor devices, from logic (arithmetic units) and memory (memory devices) to discrete devices (individual semiconductors). Demand for these gases is increasing rapidly as manufacturers increase their manufacturing capacity.

To increase its capacity, Nippon Sanso Holdings Corporation, a member of the MCG Group, has started manufacturing B_2H_6 , which was previously manufactured only in Japan, also in Korea and China. While the Japanese market mostly depended on imports for its supply of rare gases (krypton and xenon), the company is steadily preparing to establish stable supplies with the installation of new production equipment at its domestic plant.



Total Gas Center

In addition, the company has established a "Total Gas Center" equipped with ultrapure nitrogen production equipment and electronics material gas supply facilities adjacent to a customer's manufacturing plant to provide stable supplies of nitrogen and material gases via pipeline 24 hours a day.

Also, for semiconductor manufacturing plants that are almost entirely unmanned, the company has developed an "Intelligent Gas Supplying System (IGSS)," a next-generation gas supply system that automates gas supply and management using robots, AI, and other state-of-the-art technologies.

The company supports customers with total solutions that go beyond the production and supply of electronics material gases.



Next-generation gas supply system
"Intelligent Gas Supplying System (IGSS)"

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* Images shown in this document include artist renditions.